KEY TO A SCHOOL ARITHMETIC FOR INDIAN SCHOOLS

By HALL, STEVENS AND SIMS

MACMILLAN AND CO, LIMITED
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KEY

TO

HALL AND STEVENS' SCHOOL ARITHMETIC

ADAPTED FOR USE IN INDIAN SCHOOLS

BY

REV ANDREW SIMS, B.A.

LONDON MISSIONARY SOCIETY'S INSTITUTION, BHOWANIPUR, CALCUTTA

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EXAMPLES I b Page 8

13-16 See Art 8 17 $10000=625\times16$ 18-29 See Art 13

30 (i) $567=7+7\times80$ (ii) $9036=9\times1000+9\times4$

EXAMPLES I c Page 11

19 $119\overline{)103672}$ (871, 847, 142; 23 rem)

20 $233\overline{)141431}$ (607, 1631)

21 $207\overline{)177399}$ (857, 1179, 1449)

22 $471\overline{)136160}$ (289, 4196, 4280; 41 rem)

23 $593\overline{)710580}$ (1198, 1175, 5828, 4910; 166 rem)

24. $123\overline{)876513}$ (7126, 155, 324; 783 rem)

MISCELLANEOUS EXAMPLES I Page 13

4 £17875 − £2500 × 5 7 (7126 − 3785) − 257

9 Sum of the two numbers = first no + second no,
= (second no + 155) + second no,
= twice second no + 155,
twice second number + 155 = 547,
whence second number = 196, and first number = 351

16 If the cart cost 1 share of £52, each horse cost 6 shares of £52,
2 horses and cart cost 13 shares of £52,
i e 13 shares are worth £52, giving cost of each horse as £24

20 Note $9998 = 10000 - 2$, see Art 10

22 If we divide 987654321 by 164609,
we get 6000 as quotient and 321 remainder,
987654000 will divide exactly by 164609,
hence $987654000 + 164609$ or 987818609 is req^{d} number

27 $(43120 - 55) \times 7$ 30 See Art 9

34 Note $999 = 1000 - 1$, see Art 10

42 $(76428 - 53) - 611 = 125$ 45 Half of (£85 − £39)

49 A's score $= B$'s score $\times 2$, C's score $= B$'s score $\times 4$,
total score of A, B and $C = B$'s score $\times 7 = 168$,
hence B's score $= 24$, A's score $= 48$, C's score $= 96$
Total score of remaining batsmen $= 255 - 168 - 15$

51 In skeleton form the two divisions are

$$\begin{array}{r|l} 8 & \\ 9 & \text{rem } 5 \\ & \text{rem } 7 \end{array} \Big\} 61 \qquad \begin{array}{r|l} 9 & \\ 8 & \text{rem } a \\ & \text{rem } b \end{array} \Big\} 61$$

$61 = 7 \times 8 + 5$ $61 = 9b + a$, whence $b = 6$, $a = 7$

52 In skeleton form the division is

Divisor	529565	Quotient
	(i)	
246		6
	(ii)	
222		5
	(iii)	
542		

The gaps (i), (ii) and (iii) are filled by the nos 5049, 2244, 1683 respectively Each of these is some multiple of the divisor, which must be greater than 542

By trial, $5049 = 9 \times 561$, $2244 = 4 \times 561$, $1683 = 3 \times 561$
Thus divisor $= 561$, and quotient $= 943$

EXAMPLES II a. Page 25

50 For every £1 I get Rs 15,

for £37½ I get Rs $15 \times 37\frac{1}{2} = 562$ Rs 50 cents.

EXAMPLES II d Page 31

11 (ii) 23 Rs 25 cents $\times 10 = 2325$ cents $\times 10 = 23250$ cents
$= 232$ Rs 50 cents

23 Rs 25 cents $\times 100 = 2325$ cents $\times 100 = 232500$ cents
$=$ Rs 2325

23 Rs 25 cents $\times 1000 = 2325$ cents $\times 100 = 2325000$ cents
$=$ Rs 23250

12

£	s	d	
41	5	2½	(a)
		8	
330	1	8	(i)
371	6	10½	(ii)
701	8	6½	(iii)

The sum of (a) and (i) gives (ii)
(i) and (ii) gives (iii)

13

£	s	d	
37	15	7	
		29	
	12 |	203	
		16	11d
		29	
		145	
	20 |	451	
		22	11s
		87	
		203	
		£1095	

14

£	s	d	
23	2	7	
		79	
	12 |	553	
		46	1d
		158	
	20 |	204	
		10	4s
		158	
		237	
		£1827	

15

£	s	d	
27	6	4	
		122	
	3 |	122	
		40	8d
		732	
	20 |	772	
		38	12s
		244	
		854	
		£3332	

16

£	s	d
46	5	2
		177

6 | 177

29 6*d*

885

20 | 914

45 14*s*

708

1062

£8187

17

Rs	a	p
82	10	3
		141

4 | 141

35 3 p

1410

16 | 1445

90 5 a

1128

282

Rs 11652

18

Rs	a	p
173	11	9
		193

4 | 579

144 9 p

2123

16 | 2267

141 11 a

193

1351

578

Rs 33530

19

cents
4020
177

4020

28140

28140

711540 cents

=7115 Rs 40 cents

20

cents
7655
307

22965

53585

2350085 cents

=23500 Rs 85 cents

24 The former dividend=

Rs	a
5	3
	6500

16 | 19500

1218 12 a

32500

Rs 33718

The latter dividend=

Rs	a
4	6
	5250

8 | 15750

1968 12 a

21000

Rs 22968

Rs	a
33718	12
22968	12

the total dividend=Rs 56687 8 a

EXAMPLES II e Page 34

7 Rs a Rs a
(99 15−10)−(99 15−12)

12. cents
96) 864480 (9005 cents
480
90 Rs 5 cents

18 Rs
407) 8271 (Rs 20
131
16
2096 (5 a
61
12
732 (1 p
325 p = Re 1 11 a 1 p
Rs 20 5 a 1 p,
with remr Re 1 11 a 1 p

9 £ s d
56) 409 14 8 (£7
17
20
354 (6s
18
12
224 (4d

21 3s 6d = 7 sixpences,
£4 0s 6d = 161 ,,
req^d no = 161/7 = 23

23 Re 1 8 a = 3 half-rupees, Rs 148 8 a = 297 half-rupees
req^d no = 297/3 = 99

28 Division is but a short method for successive subtractions
Rs 7 10 a 3 p = 1467 p , Rs 100 = 19200 p
1467) 19200 (13
4530
129 p = 10 a 9 p
13 times, with remr 10 a 9 p

30 No of shares = total distributed − share dividend
Rs 29683 4 a = 474932 a., Rs 4 10 a = 74 a
req^d no = 474932/74 = 6418

EXAMPLES II f Page 35

18 See Art 23, Ex 2

25

Rs	a	p
5	1	3
16		
81 a		
12		
975 p		

Rs	a	p
483	0	9
16		
7728 a		
12		
92745 p		

975) 92745) 95
4995
rem^{r} 120 = 10 a

95 payments, with rem^{r} 10 a

26 Rs 600 = 60000 cents, Rs 2 55 cents = 255 cents

255) 60000 (235
900
1350
75 cents

235 days, with rem^{r} 75 cents

31 £1 + 1s + 1d = 253d, £43 4s 5d = 10373d

req^{d} no = $\frac{10373}{253}$ = 41

32 The sum of the 4 profits = Rs 14917 15 a

average annual profit = $\frac{\text{Rs } 14917\ 15\text{ a}}{4}$

35 A's share = B's share + Rs 13

twice B's share = Rs (67 − 13) = Rs 54

Thus B gets Rs 27 and A Rs 40

36 B's share = C's share + £15, A's share = C's share + £15 + £40

three times C's share + £15 + £55 = £265,

i e C's share = $\frac{£(265-70)}{3}$ = £65

37 18 Rs 20 cents = 1820 cents, 17 Rs 25 cents = 1725 cents,

15 Rs. 45 cents = 1545 cents

By addition, twice (A's + B's + C's) share = 5090 cents,

A, B, and C together get 2545 cents,

but A and B together get 1820 cents,

C gets 725 cents = 7 Rs 25 cents

B's share = (1545 − 725) cents = 820 cents = 8 Rs 20 cents,

and A's share = (1820 − 820) cents = 1000 cents = Rs 10

38 The total tax = (850 × 11) pence = £38 19*s* 2*d*

39 The no of pounds in his income = the no of times that 11*d* is contained in £45 16*s* 8*d*, or 11000 pence Hence the req^{d} income = £1000

40 Cost price of each = $\frac{£3\ 7s\ 6d}{20} = 3s\ 4\frac{1}{2}d$
Sale „ „ = $\frac{£2\ 2s\ 6d}{12} = 3s\ 6\frac{1}{2}d$
} profit = 2*d*

41 Profit per yd = 6 p But the total profit was Rs 2 4 a = 432 p
no of yds of cloth bought and sold = $\frac{432}{6} = 72$

42 The cost of 29 mds at 15 Rs 80 cents = 458 Rs 20 cents
„ 16 „ 23 Rs 45 cents = 375 Rs 20 cents
„ 45 mds = 833 Rs 40 cents
„ 1 md = 18 Rs 52 cents

43 As in Ex 42, it will be found that 1 lb of the mixture costs 2*s* 1$\frac{1}{4}$*d*
Hence gain per pound = 2$\frac{3}{4}$*d*

44 The carriage of 1 yd = 3$\frac{3}{4}$*d*, carriage of 1 ton = £200
no of yds to the ton = $\frac{200 \times 960}{15} = 12800$

45 Total takings for 4 months = Rs 1555 14 a
takings for remaining 8 months = Rs 5000 − Rs 1555 14 a
= Rs 3444 2 a
req^{d} average = $\frac{\text{Rs } 3444\ 2\text{ a}}{8} = \text{Rs } 430\ 8\text{ a } 3\text{ p}$

EXAMPLES II g Page 39

53 There will be 240 intervals between the 1st and 241st post
no of Km = $\frac{25 \times 240}{1000} = 6$

54 The train runs 36 mi in 120 half-minutes
no of yds in half a minute = $\frac{36 \times 1760}{120} = 528$

58 2026 yds 2 ft

18

3 | 36 ft

12

2026

16208

36480 yds

24

72960

145920

1760 | 875520 | 497 mi

17152

13120

800

The daily run = (2026 yds 2 ft) × 18 × 24
= 497 mi 800 yds

59 Average advance per day = $\frac{67 \text{ mi } 500 \text{ yds}}{31}$
= 2 mi 300 yds

mi	yds
31) 67	500 (2
62	
5	
1760	
31) 9300 (300	

Km	m
2	177
	31
65	31
2	177
67	487

Remr = 67 Km 500 m − 67 Km 487 m
= 13 m

60 In 45 secs. the drum makes $\frac{45}{1} \times 2$, or 30 revolutions Each revolution gives off 44 ft 6 in of rope, hence depth of shaft = 44 ft 6 in × 30 = 435 yds

EXAMPLES II h Page 41

25 1 ton = 20 cwt = (20 × 4) qr = (20 × 4 × 28) lbs = 2240 lbs
1 tonne = 1000 Kg = (1000 × $2\frac{1}{5}$) lbs = 2000 lbs + $\frac{1}{5}$ of 1000 lbs
= 2200 lbs

38 One bottle of each requires $1\frac{1}{2}$ seers
2 mds 1 seer = 162 half-seers, $1\frac{1}{2}$ seers = 3 half seers
req^{d} no of bottles = $\frac{162}{3}$ = 54

40 Total length=(4 ft 3 in ×48)=68 yds
Weight=(3×68) oz =204 oz =12 lbs. 12 oz.

ft	in
4	3
	8
34	0
	6
204	0=68 yds

41. Weight of rope=($2\frac{1}{2}$×280) lbs =(560+140) lbs =700 lbs
=6 cwt 1 qr
Adding weight of load we get total weight=2 tons 16 cwt 1 qr

EXAMPLES II k. Page 46

34 Area of the 16 flower beds
=50 sq yds 5 sq ft ×16
=808 sq yds 8 sq ft
Area of lawn is obtained by subtracting the areas of the beds and of the paths from the whole area

sq yds	sq ft
50	5
	4
202	2
	4
808	8

sq yds	sq ft
1300	0
808	8
241	1
250	0

41 (i) 1 ac.=4 r =(4×40) sq p =160 sq p =(160×30$\frac{1}{4}$) sq yds
=(4800+40) sq yds
=4840 sq yds
(ii) 1 sq mi =(1760×1760) sq yds =3097600 sq yds
=(3097600−4840) ac
=640 ac

55 6 ac 0 r 25 p =985 p , 215 ac 1 r 35 p =34475 p
req^{d} no =$\frac{34475}{985}$=35

EXAMPLES II l Page 52

3 See Art 39

11 Each truck carries (42×8) cub ft, or 336 cub ft
112 cub yds =(112×27) cub ft, or 3024 cub ft
req^{d} no of trucks=$\frac{3024}{336}$=9

13 Since 7 yds =21 ft, vol of time=(21×1×1) cub ft =21 cub ft
its weight=(64×21) lbs =1344 lbs =12 cwt

14. Actual volume of water $=(5\times4\times3)$ cub ft $=60$ cub ft

its weight $=(60\times1000)$ oz $=3750$ lbs

Estimate $=1\frac{1}{2}$ tons $=1$ ton 10 cwt $=3360$ lbs ,

so that I overestimate by 390 lbs

15 The volume of the cube = the volume the water is raised

" " $=18\times18\times18=5832$ cub in

The area of the base of the vessel $=72\times27=1944$ sq in

the no of inches the water is raised $=\frac{5832}{1944}=3$

EXAMPLES II m Page 53

9 The daily no of strokes $=(1+2+3+4+\ \ +12)\times2$

Feby 1912 has 29 days

no of strokes $=78\times2\times29=4524$

11 On the last day of 1910 the no of the paper was 5030

$$365\overline{)5030}(13$$
$$\underline{1380}$$
$$285$$

So the paper would then have been published over 13 years But there were two leap years in these 13 years the paper would then have been published 13 years and 283 days, *i e* on and from March 24th, 1897

12 Had the person been born on Dec 31st, 1891, his age would have been 19 years

These 19 years $=(19\times365+4)$ days $=6939$ days

his age was $6939-24=6915$ days

EXAMPLES III a Page 56

46 1 lb of tea costs $30d$, x lbs of tea cost $30x$ pence

1 lb of coffee costs $18d$, y lbs of coffee cost $18y$ pence

52 $4x+2p+1-z=4\ 3+2\ 1+9-0=12+2+9=\overline{23}$

54. $5xq-y+22-7l=5\ 3\ 7-5+22-7\ 9=127-68=59$

55 $93-v^2-3y^2-8p^3=93-3^2-3\ 5^2-8\ 1^3=93-9-75-8=1$

59 $\frac{4r}{z}+5xq^2p-\frac{q^2}{q}=\frac{4}{3}\frac{9}{}+5\ 0\ 7^2\ 1-\frac{7^2}{7}=12+0-7=5$

EXAMPLES III f Page 69

3 Let x be the number, then $4(2x+3)=52$

4 Let r be one part, then $60-r$ is the other part
Hence $3x-100=200-8(60-x)$

5 Let £x be C's share, then B's share is £$(r+8)$, and A's share is £$(x+8+15)$
Hence $x+(r+8)+(x+8+15)=67$

6 Let £r be A's share, then B's share is £$2r$, and C's is £$(2r-4)$
Hence $x+2x+(2x-4)=66$

7 Let A have £x, then B has £$(r+10)$, and C has £$3x$
Hence $x+(r+10)+3x=85$

8 Let A have £r, then B has £$(x+37)$, and C has £$(2x+11)$
hence $r+(r+37)+(2x+11)=188$

9 Let r be number of shillings, then $67-x=$number of sixpences
x shillings $+(67-r)$ sixpences $=$£2 13s 6d,
or, reducing to sixpences, $2x+67-r=107$

10 Let A have Rs r, or $4r$ four-anna pieces,
then B has Rs $(12-r)=(48-4x)$ four-anna pieces
Hence $4x+5=7(48-4r-5)$

11 Let B have x shillings, then A has $3x$ shillings
hence $3r-10=2(x+10)$

12 Let one have x shillings, then the other has $(30-x)$ shillings

hence $x-6=\frac{1}{2}$ of $(30-x+9)$,

and, multiplying by 2, $2(x-6)=39-x$

EXAMPLES IV a Page 76

1-13 See Art 78 In Ex 13 the work is shortened by "casting out nines," as explained in Art 12

14 "Casting out nines" from the last example (see Art 12), we get 12, 3, 9, 0, 11, 2 Since final rem is 2, the missing digit must be 7

15 From Art 77, we have in the last example,

sum of odd digits $=5+8+6+2=21$,

sum of *given* even digits $=4+7+8=19$,

missing even digit must be 2

17-34 See Art 82

32
$$\begin{array}{r|l} 5 & 7245 \\ 9 & 1449 \\ 7 & 161 \\ & 23 \end{array}$$

No $=5\times9\times7\times23$,

$=3^2\times5\times7\times23$

33
$$\begin{array}{r|l} 2 & 19206 \\ 9 & 9603 \\ 11 & 1067 \\ & 97 \end{array}$$

No $=2\times9\times11\times97$,

$=2\times3^2\times11\times97$

34
$$\begin{array}{r|l} 12 & 249984 \\ 12 & 20832 \\ 8 & 1736 \\ 7 & 217 \\ & 31 \end{array}$$

No $=12\times12\times8\times7\times31$,

$=2^2\times3\times2^2\times3\times2^3\times7\times31$,

$=2^7\times3^2\times7\times31$

40 From Art 78, the test for 8 is satisfied,

and we get $712=8\times89=2^3\ 89$, since 89 is prime

43 Taking the primes in order, we find that the tests for 2, 3, 5 are not satisfied We then try 7, 11, 13, 17, 19, 23, and find $667=23\times29$ Since 29 is prime, this is the req^{d} result

44 As in no 43, we find that 2, 3, 5, 7 are not factors, but that 11 is a factor, giving $10681=11\times971$ We then find that 971 will not divide by any of the primes 13, 17, , 37, 971 is a prime (see Art 82, Ex 3), and req^{d} result $=11\times971$

47 $100a+10b+c$ This is divisible by 2 or 5, when c is so divisible

49 $100l+10m+n$, $100m+10n+l$ } are any two such numbers

Their difference is $99l-99m-9n$, which is obviously divisible by 9

EXAMPLES IV b Page 78

18-27 See Art 84, Ex 1, 2

23 Since $10082=2\times5041$, and 5041 is odd,
2 occurs to an *odd* power, 10082 is not a square number

25 Here $3136=8\times8\times49$,
$=8^2\times7^2$,
sq root of $3136=8\times7=56$

$8\,|\,3136$
$8\,|\,392$
49

27 Here $7056=12\times12\times49$,
$=12^2\times7^2$,
sq root of $7056=12\times7=84$

$12\,|\,7056$
$12\,|\,588$
49

28 $392=4\times49\times2=(2^2\times7^2)\times2$, req^{d} factor $=2$

36 Here $46656=12\times12\times12\times27$,
$=12^3\times3^3$,
cube root of $46656=12\times3=36$

$12\,|\,46656$
$12\,|\,3888$
$12\,|\,324$
27

37 Here $91125=9\times9\times9\times125$,
$=9^3\times5^3$,
cube root of $91125=9\times5=45$

$9\,|\,91125$
$9\,|\,10125$
$9\,|\,1125$
125

39 The no must contain 13^2, or 169, as a factor, and every other factor must be twice repeated Thus we have to select from 169×2^2, 169×3^2, , and of these 169×3^2, or 1521 is the only one between 1000 and 2000

EXAMPLES IV d Page 82

1

1	117	221	1
	104	117	
	13	104	8
		104	

HCF = 13

2

1	203	319	1
	116	203	
3	87	116	1
	87	87	
		29	

HCF = 29

3

2	559	817	1
	516	559	
	43	258	6
		258	

HCF = 43

4 See Art 91

644 = 4 × 161,

532 = 4 × 133

1	161	133	4
	133	112	
4	28	21	3
	7	21	

HCF = 4 × 7 = 28

5

1	255	391	1
	136	255	
	119	136	1
	119	119	
		17	

HCF = 17

6

2	329	799	2
	282	658	
	47	141	3
		141	

HCF = 47

7 See Art 91

5	527	1147	2
	465	1054	
2	62	93	3
	31	93	

HCF = 31

8 See Art 91

2	623	833	1
	420	623	
29	203	30	210
	203		7

HCF = 7

9 See Art 91

348 = 4 × 87,

1024 = 4 × 256

1	87	256	2
	82	174	
	5	82	

At this stage we see that 87 and 256 are prime to each other,

HCF req^{d} = 4

10 See Art 91

1702 = 2 × 851

1998 = 2 × 9 × 111

7	851	111	3
	777	111	
2	74		
	37		

HCF = 37 × 2 = 74

11

1	3451	9367	2
	2465	6902	
2	986	2465	2
	986	1972	
		493	

HCF = 493

12 See Art 91

	1379	2401	1
	1022	1379	
1	357	1022	2
	308	714	
7	49	308	6
	49	294	
		2	14
			7

HCF = 7

13 See Art 91

4	4199	5083	1
	3536	4199	
2	663	884	1
	221	884	

H C F = 221

14 See Art 91

10520 = 4 × 10 × 263

11	2893	263
	2893	

H C F = 263

15 See Art 91

3	13547	17081	1
	10602	13547	
5	2945	3534	6
	589	3534	

H C F = 589

16 See Art 91

1	20677	31279	1
	10602	20677	
5	10075	9 10602	
1	2015	1178	1
	1178	837	
9	837	341	11
	3 93	341	
	31		

H C F = 31

17 See Art 91

13563 = 9 × 1507

7	10549	1507
	10549	

H C F = 1507

18 See Art 91

16984 = 4 × 2 × 2123,

5404 = 4 × 1351

1	2123	1351	7
	1351	1351	
4	772		
	193		

H C F = 193 × 4 = 772

19 See Art 91

16995 = 3 × 5 × 11 × 103,

64890 = 2 × 5 × 3 × 3 × 721

103	721	7
	721	

H C F = 103 × 3 × 5

= 1545

20 $94248 = 2^3\ 3^2\ 7\ 11\ 17$,

$504900 = 2^2\ 5^2\ 3^3\ 11\ 17$,

$H C F = 2^2\ 3^2\ 11\ 17$

= 6732

21. 183 = 61 × 3,

793 = 61 × 13,

976 = 61 × 16,

H C F = 61

22 658 = 2 × 47 × 7,

940 = 2 × 47 × 10,

1128 = 2 × 47 × 12,

H C F = 2 × 47 = 94

23 403 = 31 × 13,

744 = 31 × 6 × 4,

1023 = 31 × 3 × 11,

H C F = 31

24 See Arts 91 and 92

42237 = 9 × 4693,

75582 = 9 × 2 × 4199,

8892 = 9 × 4 × 247

We now find the H C F of 4693, 4199, 247

1	4693	4199	17
	4199	247	
2	494	1729	
	247	1729	

We obtain for this 247,

req^d H C F = 9 × 247

= 2223

25 3156 = 9 × 3 × 27,

26244 = 9 × 3 × 972,

99225 = 9 × 3 × 3675

Since 27, 972, and 3675 have no factor common to all three, it follows that

H C F = 27

26 The req^d number must divide the numbers (14490 − 6) and (31530 − 6) without remainder

31

2	385	525	1	Starting from the remainder 35, we can build up the work step by step till we arrive at the two numbers required
	280	385		
3	(i) 105	(ii) 140	1	
	3×35	105		
		35		

Thus 3×35, or 105, must equal the remainder (i), $105\times1+35$ must equal the remainder (ii), whence we get 140 Then $2\times140+105$ gives 385, and $385\times1+140$ gives 525

32 The required number will divide the difference between any two of the three numbers and leave no remainder

Now $153599-142408=11191$,

and $166402-153599=12803$,

hence req^{d} no is the H C F of 11191 and 12803

33 (iii)) 40051 ((iv)

(ii)

1731

(i)

294

The gaps are filled as follows

(i) $=1731-294=1437$,

(ii) $=4005-173=3832$

Now 1437 (or 479×3) and 3832 (or 479×8 are multiples of the req^{d} divisor

Hence divisor=479, and quotient=83

EXAMPLES IV f Page 86

1–7 See Art 97 8 $2s\ 6d=5$ sixpences, $10s\ 6d=21$ sixpences, L C M of 5 and 21=105

11 The lowest number which each of the four given numbers will divide *without remainder*, is their L C M

This will be found to be 720, hence (720+9) is req^{d} number

14 Reduce to threepences See Ex 8

15 The answer must be the *least number*, which will contain 105, 112, 126, and 168 miles an exact number of times

16 As Ex 15

17 The req^{d} time in secs must divide exactly by each of the numbers 252, 308, and 198, since by then, A, B, and C must each have completed an exact number of rounds

they will *next* be all together in the L C M of 252 secs, 308 secs, and 198 secs

18 From Art 97, $\text{L C M}=\frac{A\ B}{X}$, or $11781=\frac{1071\times B}{119}$

EXAMPLES V d Page 93

12 $\frac{315}{420}=\frac{3\times105}{3\times140}=\frac{3\times5\times21}{3\times5\times28}=\frac{3\times5\times7\times3}{3\times5\times7\times4}=\frac{3}{4}$

16 $\frac{231}{3003}=\frac{3\times77}{3\times1001}=\frac{3\times11\times7}{3\times11\times91}=\frac{3\times11\times7\times1}{3\times11\times7\times13}=\frac{1}{13}$

20 $\frac{2508}{3036}=\frac{11\times228}{11\times276}=\frac{11\times12\times19}{11\times12\times23}=\frac{19}{23}$

27 $\frac{391}{408}=\frac{391}{3\times8\times17}$ (a)
$=\frac{17\times23}{3\times8\times17}$
$=\frac{23}{24}$

(a) At this stage we see neither 3 nor 8 divides 391 Hence, if the fraction admits of reduction, 17 must be a factor of 391
By division we obtain the other factor 23

28-29 See Art 107, Ex 1

34 $\frac{572}{1287}=\frac{4\times11\times13}{9\times11\times13}=\frac{4}{9}$

35 $\frac{954}{2544}=\frac{2\times3\times3\times53}{2\times3\times8\times53}=\frac{3}{8}$

EXAMPLES V g Page 98

47 LCD of 39, 65, 15 $=3\times5\times13=195$,
$\exp^n=\frac{5+21-13}{195}=\frac{13}{195}=\frac{13\times1}{13\times15}=\frac{1}{15}$

48 LCD of 35, 21, 15 $=3\times5\times7=105$,
$\exp^n=\frac{36-20+49}{105}=\frac{65}{105}=\frac{5\times13}{5\times21}=\frac{13}{21}$

49 LCD of 12, 36, 27 $=4\times3^3=108$,
$\exp^n=\frac{99-15-8}{108}=\frac{76}{108}=\frac{4\times19}{4\times27}=\frac{19}{27}$

EXAMPLES V h Page 100

17 $\text{Exp}^n=1+\frac{5}{5}+\frac{10}{30}+\frac{7}{60}+\frac{11}{10}=1+\frac{15+76}{15\times3\times4}+\frac{7+33}{60}$
$=1+\frac{91}{15\times12}+\frac{2}{3}=1+\frac{7}{12}+\frac{2}{3}=2\frac{1}{4}$

18 $\text{Exp}^n=9+\frac{0}{77}+\frac{7}{33}+\frac{10}{11}+\frac{48}{03}=9\frac{27+40+210}{21\times11}+\frac{10}{21}$
$=9\frac{280}{21\times11}+\frac{10}{21}=9\frac{20+10}{21}=11$

19 $\text{Exp}^n=\frac{21-8}{13\times6}+\frac{1}{6}=\frac{13}{13\times6}+\frac{1}{6}=\frac{1}{6}+\frac{1}{6}=\frac{1}{3}$

20 Exp^{n} $=3\frac{16-9}{7\times3\times8}-\frac{1}{24}=3\frac{7}{7\times24}-\frac{1}{24}=3\frac{1}{24}-\frac{1}{24}=3$

21 Exp^{n} $=\frac{2}{5}-\frac{7}{55}-\frac{3}{11}=\frac{22-7-15}{55}=0$

22 Exp^{n} $=1\frac{5}{77}-\frac{2}{55}-\frac{1}{35}=1\frac{25-14}{11\times5\times7}-\frac{1}{35}$

$=1\frac{11}{11\times5\times7}-\frac{1}{35}=1\frac{1}{35}-\frac{1}{35}=1$

EXAMPLES V k Page 101

38 $3-(2\frac{2}{9}-\frac{5}{6})=3-2\frac{2}{9}+\frac{5}{6}=\frac{7}{9}+\frac{5}{6}=\frac{28+30}{36}=1\frac{11}{18}$

39 $3\frac{1}{8}-1\frac{1}{6}=2\frac{1}{8}-\frac{1}{6}=2+\frac{3-4}{24}=1+\frac{24+3-4}{24}=1\frac{23}{24}$

$2-\frac{1}{12}=1\frac{11}{12}=1\frac{22}{24}$

first exp^{n} is greater by $\frac{1}{24}$

41 $2\frac{1}{2}-\frac{3}{5}+\frac{9}{10}=2+\frac{5-6+9}{10}=2\frac{8}{10}=2\frac{4}{5}$, $\frac{1}{5}$ must be added

42 $10-(\frac{11}{3}-\frac{5}{7})=10-\frac{11}{3}+\frac{5}{7}=10-3\frac{2}{3}+\frac{5}{7}=7+\frac{5}{7}-\frac{2}{3}$

$=7+\frac{15-14}{21}=7\frac{1}{21}$ Hence req^{d} diff $=\frac{1}{21}$

43 (i) $6\frac{2}{9}-x=1\frac{5}{18}$, (ii) $v+1\frac{1}{8}-\frac{5}{120}=1\frac{3}{5}$,

or $-6\frac{2}{9}+v=-1\frac{5}{18}$, $v=1\frac{3}{5}+\frac{7}{120}-\frac{1}{8}$,

$v=6\frac{2}{9}-1\frac{7}{18}$, or $v=\frac{8}{15}$

or $v=4\frac{5}{6}$

EXAMPLES V l Page 103

11 Exp^{n} $=3\frac{10}{11}+3\frac{2}{5}-1\frac{8}{55}-4\frac{9}{10}=1+(\frac{10}{11}-\frac{9}{22})-(\frac{9}{10}-\frac{2}{5})$

$=1+\frac{11}{22}-\frac{5}{10}=1+\frac{1}{2}-\frac{1}{2}=1$

12 Exp^{n} $=8+(\frac{1}{2}+\frac{3}{8})-(\frac{13}{72}+\frac{1}{30})=8+\frac{7}{8}-\frac{15}{72}$

$=8+\frac{7}{8}-\frac{5}{24}=8\frac{16}{24}=8\frac{2}{3}$

13 Exp^{n} $=\frac{8}{45}-\frac{1}{7}+\frac{2}{35}+\frac{11}{63}=\frac{50-45+18+55}{5\times7\times9}=\frac{84}{5\times7\times9}=\frac{4}{15}$

14 Exp^{n} $=1-(\frac{9}{34}-\frac{5}{51})+(\frac{7}{18}-\frac{2}{9})=1-\frac{17}{102}+\frac{3}{18}=1-\frac{1}{6}+\frac{1}{6}=1$

17 $(\frac{3}{4}+\frac{6}{7}+\frac{7}{12})-\frac{4}{21}=\frac{6}{7}-\frac{4}{21}+\frac{9+7}{12}=\frac{2}{3}+1\frac{1}{3}=2$

18 $(8\frac{5}{51}-3\frac{2}{9})-(10\frac{9}{34}-5\frac{17}{18})=8\frac{5}{51}-3\frac{2}{9}-10\frac{9}{34}+5\frac{17}{18}$

$=(\frac{17}{18}-\frac{2}{9})-(\frac{9}{34}-\frac{5}{51})=\frac{13}{18}-\frac{17}{102}=\frac{13}{18}-\frac{1}{6}=\frac{5}{9}$

19 $(2\frac{2}{5}-\frac{4}{5})-(1\frac{3}{10}-\frac{1}{7})=2\frac{2}{5}-\frac{4}{5}-1\frac{3}{10}+\frac{1}{7}$
$=1+(\frac{1}{7}+\frac{7}{7})-(\frac{4}{5}+\frac{3}{10})=1+\frac{8+14}{5\times7\times11}-\frac{1\times8}{10\times5}$
$=1+\frac{22}{77}-\frac{4}{77}=1+\frac{7\times2}{5\times7\times2}=1\frac{1}{5}$

20 Req^d amount $=$ Rs $(2\frac{1}{2}+1\frac{1}{7})-$ Rs $(3\frac{1}{6}+\frac{1}{12})$
$=$ Rs $(2\frac{1}{2}+1\frac{1}{7}-3\frac{1}{6}-\frac{1}{12})=$ Re $(\frac{1}{2}+\frac{1}{7}-\frac{1}{6}-\frac{1}{12})$
$=$ Re $(\frac{3}{4}-\frac{1}{4})=$ Re $\frac{1}{2}$ or 8a

21 Req^d amount $=$ £10 $-$ £$(2\frac{1}{5}+4\frac{3}{10}+\frac{1}{40})$
$=$ £4 $-$ £$(\frac{1}{5}+\frac{7}{10}+\frac{1}{40})=$ £4 $-$ £$\frac{7}{8}\frac{0}{0}=$ £3$\frac{8}{8}\frac{1}{0}=$ £3 5s 3d

22 Req^d fraction $=(1-\frac{5}{24}-\frac{7}{10}-\frac{1}{7})=\frac{7}{168}$
we get first sum $=\frac{5}{24}$ of Rs 240 $=$ Rs 50,
second sum $=\frac{7}{10}$ of Rs 240 $=$ Rs 72,
third sum $=\frac{1}{5}$ of Rs 240 $=$ Rs 48,
fourth sum $=\frac{7}{24}$ of Rs 240 $=$ Rs 70

23 A owes B 4s $7\frac{3}{4}d$ in all This to the nearest penny is 4s 8d
A pays B 5s , B pays A 4d

24. Length of rod $=(10\frac{5}{8}+40\frac{3}{8}+38\frac{1}{4}-5\frac{1}{2})$ in
$=(81+38\frac{1}{4}-5\frac{1}{2})$ in $=113\frac{3}{4}$ in $=114$ in to nearest inch

25 Residue $=(1-\frac{1}{3}-\frac{1}{4}-\frac{1}{5}-\frac{2}{15})=\frac{1}{12}$ of property
$\frac{1}{12}$ of property $=$ Rs 1200, and whole property $=$ Rs 14400

26 $\frac{2}{7}+\frac{1}{5}+\frac{1}{10}+\frac{1}{12}+\frac{1}{20}=\frac{5}{6}$
"the rest" consist of $\frac{1}{6}$ of 350000, or 58333

27 (i) $\frac{a+b}{a}+\frac{a+b}{b}-2$
$=\frac{(a+b)\times b+(a+b)\times a-2ab}{ab}$
$=\frac{ab+b^2+a^2+ab-2ab}{ab}$
$=\frac{a^2+b^2}{ab}$

If $a=2$ and $b=3$,
then $\frac{a+b}{a}+\frac{a+b}{b}-2$
$=\frac{5}{2}+\frac{5}{3}-2=2\frac{1}{6}$
Also $\frac{a^2+b^2}{ab}=\frac{2^2+3^2}{6}=2\frac{1}{6}$

(ii) $\frac{a-b}{a^2b}-\frac{1}{ab^2}+\frac{1}{a^2b}$
$=\frac{a-b-a+b}{a^2b^2}$
$=0$

If $a=2$ and $b=3$,
then $\frac{a-b}{a^2b^2}-\frac{1}{ab^2}+\frac{1}{a^2b}$
$=\frac{2}{36}-\frac{1}{18}+\frac{1}{12}$
$=\frac{1}{12}-\frac{1}{18}-\frac{1}{36}=0$

EXAMPLES V n Page 109

15 The daughter's share is $(1-\frac{5}{8})$, or $\frac{3}{8}$ of the estate
req^d value $=\frac{3}{8}$ of £5650 = £2118 15*s*

16 $(1-\frac{11}{18})$ or $\frac{5}{18}$ of the distance remains
req^d no of Km $=\frac{7}{18}$ of 896 = 280

17 I possess $\frac{7}{11}$ of Rs 3,00,000 or Rs. 1,75,000
req^d amt = Rs 1,75,000 − Rs 25,000 = Rs 1,50,000

18 $(1-\frac{13}{18})$ or $\frac{5}{18}$ of the amount remains
Since $\frac{5}{18}$ of 1620 tons = 450 tons,
req^d time $=\frac{450}{90}$ days = 5 days

19 The senior partner gets $\frac{4}{11}$ of £10043 or £3652,
„ second „ „ $\frac{3}{11}$ of £10043 or £2739,
„ third „ „ $\frac{2}{11}$ of £10043 or £1826
The reserve fund = £(10043 − 3652 − 2739 − 1826) = £1826

20 $(1-\frac{3}{8})$ or $\frac{5}{8}$ of the cargo remained good. Now $\frac{1}{8}$ of 12000 = 7500,
and req^d profit = Rs $2\times\frac{7500}{100}$ = Rs 150

EXAMPLES V p Page 113

36 A major's pay $=\frac{8}{9}$ of 18*s* = 16*s*,
hence a captain's pay $=\frac{21}{30}$ of 16*s* = 11*s* 6*d*

37 *B*'s age $=\frac{4}{5}$ of *C*'s $=\frac{4}{5}$ of 15 yrs = 20 yrs,
A's age $=\frac{5}{4}$ of *B*'s $=\frac{5}{4}$ of 20 yrs = 25 yrs,
M's age = (25 + 20 + 15) yrs = 60 yrs

38 In Dec. 1905 its value $=\frac{5}{6}$ of Rs 1,20,000 = Rs 1 00,000
In Dec. 1906 „ $=\frac{5}{6}$ of Rs 1,00,000 = Rs 83,333 5 a 4 p

39 Since the rule is $\frac{1}{11}$ ft too short,
the apparent length of 1 ft is really $\frac{11}{11}$ ft,
„ „ 24 ft „ $\frac{11}{11}$ of 24 ft, or 22 ft,
and „ „ 20 ft „ $\frac{11}{11}$ of 20 ft, or $18\frac{1}{3}$ ft
Had each foot of the rule been $\frac{1}{11}$ ft too long,
a real length of $1\frac{1}{11}$ ft would have appeared to be 1 ft
„ „ 1 ft „ „ „ $\frac{12}{11}$ ft
„ „ 22 ft „ „ „ $\frac{12}{13}$ of 22 ft., or $20\frac{4}{11}$ ft
„ „ $18\frac{1}{3}$ ft „ „ „ $\frac{12}{13}$ of $18\frac{1}{3}$ ft, or $16\frac{12}{13}$ ft

40 Total amount cut off $= \frac{7}{15} + \frac{3}{10}$ of $\frac{8}{15} = \frac{17}{30}$,
fraction of stick left is $\frac{13}{30}$

41 Total distance he rides $= \frac{18}{25} + \frac{1}{14}$ of $\frac{5}{25} = \frac{39}{50}$,
distance he walks $= \frac{11}{50}$

42 The first has $\frac{5}{24}$ of 48*s*, or 14*s*,
the second has $\frac{8}{17}$ of 34*s*, or 16*s*,
and the third has $\frac{2}{9}$ of 18*s*, or 4*s*,
whence the fourth has (48 − 14 − 16 − 4)*s*, or 14*s*

EXAMPLES V q Page 116

25 Let x be the req^{d} fraction, then $4\frac{5}{8} \times x = 4\frac{1}{2}$, or $x \times \frac{39}{8} = \frac{9}{2}$ Multiplying both sides by $\frac{8}{39}$, we have $x \times \frac{39}{8} \times \frac{8}{39} = \frac{9}{2} \times \frac{8}{39}$, or $x = \frac{12}{13}$

26 Req^{d} no $= \frac{\text{dividend}}{\text{quotient}} = 4\frac{7}{12} - 1\frac{1}{3} = \frac{55}{12} - \frac{4}{3} = \frac{55}{12} \times \frac{3}{4} = 3\frac{7}{16}$

27 Req^{d} no of times $= 15 - (4\frac{1}{8}$ of $\frac{4}{11}) = 15 - \frac{1}{2} = 15 \times \frac{2}{3} = 10$

28 We have $10\frac{2}{3} - (2\frac{2}{7} \times 2\frac{4}{7}) = \frac{32}{3} - \frac{16}{3} = \frac{32}{3} \times \frac{1}{16} = 2$

29 (i) $\frac{5}{8}$ mi $= 1$ Km,
$\frac{5}{8} \times \frac{8}{5}$ mi $= \frac{8}{5}$ Km,
or 1 mi $= 1\frac{3}{5}$ Km

(ii) From (i)
1 mi $= 1\frac{3}{5}$ Km,
1 mi $= 1\frac{3}{5} \times 1000$ m $= 1600$ m

(iv) $39\frac{3}{8}$ in $= 1$ m,
hence 1 in $= (1 - 39\frac{3}{8})$ m
36 in $= \frac{36}{39\frac{3}{8}}$ m $= \frac{32}{35}$ m

(v) $39\frac{3}{8}$ in $= 1$ m,
or $39\frac{3}{8}$ in $= 100$ cm,
whence 1 in $= \frac{100}{39\frac{3}{8}}$ cm $= 2\frac{24}{63}$ cm

30 (ii) 1 cwt $= 112$ lbs $= 112 \times \frac{5}{11}$ Kg $= 50\frac{10}{11}$ Kg

(vi) 1 litre $= \frac{7}{4}$ pints,
1 Kl $= \frac{7}{4} \times 1000$ pints
$= \frac{7 \times 1000}{4 \times 8}$ gals
$= 218\frac{3}{4}$ gals

(vii) 1 gram $= \frac{1}{1000}$ of $2\frac{1}{5}$ lbs
$= \frac{1}{1000} \times \frac{11}{5} \times 7000$ grs
$= 15\frac{2}{5}$ grs

EXAMPLES V r Page 119

4 $\text{Exp}^{n}=3\frac{1}{2}+\frac{2}{5}\times\frac{3}{1}=3\frac{1}{2}+1\frac{1}{5}=4+\frac{5+2}{10}=4\frac{7}{10}$

5 $\text{Exp}^{n}=\frac{7}{2}\times\frac{r}{2}+\frac{1}{3}=8\frac{1}{4}+\frac{1}{3}=9\frac{1}{12}$

6 $\text{Exp}^{n}=3\frac{1}{2}+(\frac{2}{5}\times\frac{1}{3})=3\frac{1}{2}+\frac{2}{15}=3\frac{19}{30}$

13 $\text{Exp}^{n}=\frac{24}{5}\times\frac{5}{3}-\frac{1}{2}=8-\frac{1}{2}=7\frac{1}{2}$

14 $\text{Exp}^{n}=(5\frac{2}{5})\times\frac{1}{2}=2\frac{7}{10}$

15 $\text{Exp}^{n}=4\frac{4}{5}+(1\frac{3}{10})=5\frac{1}{10}$

22 $\text{Exp}^{n}=(4+\frac{21-8}{78})-(2+\frac{4-1r}{18})=4\frac{13}{78}-(1+\frac{18+4-15}{18})$

$=4\frac{1}{6}-1\frac{7}{18}=\frac{25}{6}\times\frac{18}{25}=3$

23 $\text{Exp}^{n}=(1\frac{3}{4}\times1\frac{3}{3})-(2\frac{1}{6})\times(3\frac{1}{4})=\frac{13}{4}\times\frac{13}{3}\times\frac{6}{13}\times\frac{11}{4}=21\frac{1}{8}$

24 $\text{Exp}^{n}=(\frac{5+12}{20})(\frac{3r-30}{42})-(\frac{63-56}{7\ 2})=\frac{17}{20}\times\frac{r}{42}\times\frac{72}{7}=1\frac{29}{40}$

25 $\text{Exp}^{n}=(\frac{6+10}{67})-(2\frac{2}{3})\times\frac{8}{16}=\frac{2}{5}\frac{r}{7}\times\frac{3}{8}\times\frac{8}{16}=\frac{r}{67}$

26 $\text{Exp}^{n}=\frac{4}{5}+(\frac{r}{8}\text{ of }\frac{16}{25})+(\frac{9}{17}\text{ of }\frac{34}{63})=\frac{4}{5}+\frac{2}{5}+\frac{r}{7}=\frac{6}{5}+\frac{1}{5}+\frac{2}{7}=1\frac{17}{35}$

27 $\text{Exp}^{n}=(\frac{5}{13}\times\frac{30}{25})+2\frac{3}{10}-(\frac{7}{18}\times\frac{36}{35})=\frac{3}{5}+2\frac{3}{10}-\frac{2}{5}=2\frac{1}{2}$

28 $\text{Exp}^{n}=(\frac{10}{3}\times\frac{9}{2})-(1\frac{13}{4}\times\frac{16}{5})-1\frac{3}{5}=24-10\frac{2}{5}-1\frac{3}{5}=24-11-\frac{r}{5}=12$

29 $\text{Exp}^{n}=2\frac{1}{3}+(\frac{4}{5}\times\frac{10}{3}\times\frac{3}{4})-2\frac{1}{2}+\frac{5}{11}=2\frac{1}{3}+2-2\frac{1}{2}+\frac{r}{11}$

$=2+\frac{1}{3}+\frac{r}{11}-\frac{1}{2}=2+\frac{22+30-33}{66}=2\frac{19}{66}$

30 $\text{Exp}^{n}=\frac{210}{105}+(\frac{4}{35}\times\frac{7}{4})-(\frac{7}{11}\times\frac{11}{3}\times\frac{6}{40})=\frac{210}{105}+\frac{1}{5}-\frac{2}{7}=\frac{30}{105}=\frac{4}{21}$

31 Req^{d} value $=(1\frac{1}{4}-\frac{3}{8})\times(7\frac{9}{16})-(1\frac{13}{16}-\frac{1}{24})$

$=\frac{7}{8}\times\frac{121}{16}-1\frac{7}{48}=\frac{7}{8}\times\frac{121}{16}\times\frac{48}{55}=5\frac{71}{40}$

32 Req^{d} value $=2\frac{1}{9}+(6\frac{1}{4}\times1\frac{3}{5})-(2\frac{1}{2}\times3\frac{2}{5}-1\frac{2}{15})$

$=2\frac{1}{9}+(\frac{25}{4}\times\frac{8}{5})-(\frac{5}{2}\times\frac{17}{5}\times\frac{1}{17})$

$=2\frac{1}{9}+10-7\frac{1}{2}=5+\frac{1}{9}-\frac{1}{2}=4+\frac{18+2-9}{18}=4\frac{11}{18}$

33 Req^{d} value $=[7\frac{1}{2}\text{ of }(9\frac{1}{2}-5\frac{1}{14})]-[(2\frac{1}{7}\text{ of }9\frac{1}{2})-5\frac{1}{14}]$

$=[7\frac{1}{2}\text{ of }4\frac{3}{7}]-[\frac{1r}{7}\times\frac{19}{2}-5\frac{1}{14}]$

$=(\frac{15}{2}\text{ of }\frac{31}{7})-(\frac{1r}{7}\times\frac{19}{2})+5\frac{1}{14}$ (See Art 51)

$=(\frac{15}{14}\times31)-(\frac{1r}{14}\times19)+5\frac{1}{14}$

$=\frac{15}{14}(31-19)+5\frac{1}{14}$ (See Art 55)

$=\frac{15}{14}\times12+5\frac{1}{14}=12\frac{12}{14}+5\frac{1}{14}=17\frac{13}{14}$

EXAMPLES V s Page 121

22 $\text{Fraction}=\frac{3\frac{1}{2}-1\frac{7}{8}}{3\frac{1}{4}\times 2\frac{1}{2}}=\frac{2\frac{4}{8}-\frac{7}{8}}{\frac{13}{4}\times\frac{5}{2}}=\frac{1+\frac{12}{8}-\frac{7}{8}}{\frac{65}{8}}=1\frac{5}{8}-\frac{6}{8}=\frac{1}{5}$

23 $\text{Fraction}=(\frac{6}{7}\times\frac{21}{20})-(\frac{54}{5}\times\frac{1}{27})=\frac{9}{10}\times\frac{5}{2}=2\frac{1}{4}$

24 $\text{Fraction}=(\frac{35}{4}\times\frac{24}{5})-(\frac{31}{4}\times\frac{8}{5})=7-1\frac{4}{5}=\frac{1}{5}$

25 $\text{Fraction}=(\frac{9}{20}\text{ of }\frac{25}{9})-(2+\frac{20-11}{10})=\frac{15}{4}-2\frac{9}{10}=1\frac{19}{41}$

26 $\text{Exp}^{n}=\frac{1\frac{1}{2}\times 2}{22\frac{1}{2}\times 2}-\frac{21\frac{1}{7}\times 3}{11\frac{1}{3}\times 3}=\frac{3}{45}-\frac{64}{4}=\frac{1}{240}$

27 $\text{Fraction}=\frac{\frac{5}{4}\times\frac{2}{3}}{\frac{1}{15}+\frac{1}{10}}=\frac{\frac{5}{4}\times\frac{2}{3}}{\frac{5}{30}}=\frac{5}{4}\times\frac{2}{3}\times\frac{30}{5}=5$

28 $\text{Fraction}=\frac{(\frac{1}{2}+\frac{3}{4}+\frac{7}{10})\times 12}{(\frac{2}{3}+\frac{1}{4}+1\frac{1}{10})\times 12}=\frac{6+9+10}{8+3+14}=1$

29 $\text{Exp}^{n}=\frac{3}{14}\text{ of }(\frac{41}{9}\times\frac{6}{37})-(\frac{82}{7}\times\frac{11}{60})=\frac{1\times 41\times 6\times 7\times 60}{14\times 9\times 37\times 8\times 11}=\frac{60}{814}$

30 $\text{Exp}^{n}=\frac{7}{15}-\frac{\frac{7}{4}}{\frac{27}{4}}=\frac{7}{15}-(\frac{7}{4}\times\frac{4}{27})=\frac{7}{15}-\frac{7}{27}=1\frac{2}{3}$

31 $\text{Exp}^{n}=\frac{3\frac{8}{17}-\frac{7}{9}}{2\frac{4}{45}}+\frac{1\frac{1}{5}}{11\frac{1}{5}-2\frac{1}{3}}=\frac{(3\frac{8}{17}-\frac{7}{9})\times 45}{2\frac{4}{45}\times 45}+\frac{1\frac{1}{5}\times 15}{(11\frac{1}{5}-2\frac{1}{3})\times 15}$

$=\frac{150-25}{133}+\frac{18}{133}=1\frac{1}{7}$

32 $\text{Exp}^{n}=\frac{3+\frac{2}{7}+\frac{4}{7}-\frac{3}{5}}{\frac{1}{3}+\frac{1}{5}+\frac{1}{7}}-(3-\frac{19}{70})=\frac{(3+\frac{2}{7}+\frac{4}{7}-\frac{3}{5})\times 105}{(\frac{1}{3}+\frac{1}{5}+\frac{1}{7})\times 105}-\frac{191}{70}$

$=\frac{315+70+60-63}{35+21+15}\times\frac{70}{191}=\frac{382}{71}\times\frac{70}{191}=1\frac{69}{71}$

EXAMPLES V t Page 122

11 Multiply by 6, then $3x+2x=30$

13 Multiply by 4, then $4x=x+24$

18 Multiply by 6, then $2(x+1)+3(x-1)=24$

21 Let x be the number, then $x+\frac{x}{3}=20$

22 Let x be the number, then $x=20-\frac{x}{4}$

23 Let x be the number, then $\frac{x}{3}-\frac{x}{5}=2$

24 $\frac{4}{7}x=\frac{8}{5}$, $x=\frac{8}{5}\times\frac{7}{4}$ 25 $\frac{3}{7}x=1\frac{4}{5}\times\frac{5}{6}$, $x=1\frac{4}{5}\times\frac{5}{6}\times\frac{7}{3}$

26 Let x and $50-x$ be the two parts, then $50-x=\frac{3x}{7}$

27 Let x and $x+6$ be the two numbers, then $x+(x+6)=28$

28 Let A have x rupees and B $(20-x)$ rupees, then $(20-x)+\frac{x}{3}=x$

29 Equation becomes $\frac{7}{2}=\frac{21}{x}$ Multiply by $2x$, then $7x=42$

30 (i) Equation becomes $\frac{3x}{2}=\frac{6\times4\times7}{14}$, or $\frac{3x}{2}=12$

Multiply by 2, then $3x=24$

(ii) Equation becomes $\frac{6\times16\times x}{8}=7$, or $12x=7$

Divide by 12, then $x=\frac{7}{12}$

(iii) Equation becomes $\frac{x}{7}=17$ Multiply by 7, then $x=119$

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8 Exp^n=Rs $4\frac{1}{16}\times\frac{3}{28}$=Rs $\frac{65}{16}\times\frac{3}{28}$=Rs $\frac{195}{64}$=8 a 3 p

9 Exp^n=Rs $6\frac{1}{4}\times\frac{12}{25}$=Rs $\frac{25}{4}\times\frac{12}{25}$=Rs 3

10 Exp^n=$81\frac{1}{3}s\times\frac{7}{16}=\frac{244}{3}s\times\frac{7}{16}=\frac{427}{12}s$ =£1 15s 7d

11 Exp^n=Rs $4\frac{3}{8}\times\frac{2}{16}$=Rs $\frac{35}{8}\times\frac{2}{16}$=Rs $\frac{70}{128}$=9 a 4 p

12 Exp^n=6 tons$\times3\frac{4}{35}$=**18** tons+6 tons$\times\frac{4}{35}$

Now 6 tons$\times\frac{4}{35}=6\times20\times\frac{4}{35}$ cwt =**13**$\frac{5}{7}$ cwt,

Again $\frac{5}{7}$ cwt $=\frac{5\times4}{7}$ qrs =**2**$\frac{6}{7}$ qrs,

and $\frac{6}{7}$ qr $=\frac{6\times28}{7}$ lbs =**24** lbs

Exp^n=18 tons 13 cwt 2 qrs 24 lbs

13 Exp^n=$105s\times\frac{17}{160}=\frac{1785}{160}s$ =£1 9s 2d

14 Exp^n=24 ft $\times1\frac{7}{30}$=24 ft $\times\frac{43}{30}=\frac{860}{30}$ ft =9 yds 1 ft 8 in

15 Exp^n=Rs $12\times\frac{11}{100}$=Re $\frac{11}{8}$=Re $1\frac{3}{8}$=Re 1 6 a

16 Exp^n=18 mds $\times2\frac{5}{24}$=18 mds $\times\frac{53}{24}=\frac{954}{24}$ mds =39 mds 30 srs

17 Since $5\frac{3}{4}=6-\frac{1}{4}$, exp^{n} = Rs.11 7a 8p $\times(6-\frac{1}{4})$
$=$Rs 11 7a 8p $\times 6-$Rs 11 7a 8p $\times\frac{1}{4}$
$=$Rs 68 14a $-$Rs 2 13a 11p $=$Rs 66 0a 1p

18 $\frac{5}{8}=\frac{4+1}{8}=\frac{4}{8}+\frac{1}{8}=\frac{1}{2}+\frac{1}{8}$

	Rs	a	p	
	3	7	4	(a)
			2	
	6	14	8	
$\frac{1}{2}$	1	11	8	$=\frac{1}{2}$ of (a)
$\frac{1}{8}$		6	11	$=\frac{1}{8}$ of (a)
	9	1	3	

19 $\frac{3}{8}=\frac{2+1}{8}=\frac{2}{8}+\frac{1}{8}=\frac{1}{4}+\frac{1}{8}$

	tons	cwt	qrs	lbs	oz	
	1	7	3	0	0	(a)
					5	
	6	18	3	0	0	
$\frac{1}{4}$		6	3	21	0	$=\frac{1}{4}$ of (a)
$\frac{1}{8}$		3	1	24	8	$=\frac{1}{8}$ of (a)
	7	9	0	17	8	

20 Exp^{n} = £4 3s 8d $\times\frac{23}{16}$, we divide £4 3s 8d by 16 and multiply the result by 23

21 Since $3\frac{7}{8}=4-\frac{1}{8}$, exp^{n} = Rs 9 6a 8p $\times(4-\frac{1}{8})$
$=$Rs 9 6a 8p $\times 4-$Rs 9 6a 8p -8
$=$Rs 37 10a 8p $-$Re 1 2a 10p $=$Rs 36 7a 10p

22 Exp^{n} = 288 p $\times\frac{11}{16}=\frac{1056}{5}$ p $=211\frac{1}{5}$ p $=1$ ac 1 r $11\frac{1}{5}$ p

23 Exp^{n} = Rs 24 11a $\times 5\frac{7}{12}=$Rs 123 7a $+$Rs 24 11a $\times\frac{7}{12}$
Now Rs.24 11a $\times\frac{7}{12}=(\frac{1}{12}$ of Rs 24 11a$)\times 7$
$=$Rs 2 0a 11p $\times 7=$Rs 14 6a 5p
exp^{n} = Rs 123 7a $+$Rs 14 6a 5p $=$Rs 137 13a 5p

24 Exp^{n} = 2 mds 30 srs 4 chks $\times\frac{5}{9}=1764$ chks $\times\frac{5}{9}$
$=980$ chks $=1$ md 21 srs 4 chks

25 Req^{d} value $=(\frac{3}{4}$ of $7+\frac{7}{22}$ of 11) half-annas
$=(3+3\frac{1}{2})$ half annas $=3$a 3p

26 Req^{d} value $=(\frac{2}{9}$ of $126+\frac{4}{11}$ of 33) sixpences $=(28+12)$ sixpences
$=$£1

27 Req^{d} value $=(\frac{7}{16}$ of $90-\frac{5}{16}$ of 192) in $=(126-120)$ in $=6$ in

28 Req^{d} value $=(\frac{3}{176}$ of $1760-\frac{5}{11}$ of 220) yds $=(330-100)$ yds
$=230$ yds

29 Req^{d} value $=(\frac{77}{16}$ of $63+\frac{45}{22}$ of 55) p
$=(\frac{385}{2}+\frac{225}{2})$ p $=$Re 1 9a 5p

30 Req^{d} value $=(\frac{16}{11}$ of $1980+\frac{7}{17}$ of 34) ft. $=2886$ ft $=962$ yds

31 Req^{d} value $=\left(\frac{5}{14}\text{ of }112+\frac{3}{13}\text{ of }52+\frac{8}{3}\text{ of }12\right)$ lbs $=(40+12+32)$ lbs
$=3$ qrs

32 Req^{d} value $=\left(\frac{3}{8}\text{ of }\frac{4}{11}\text{ of }256+\frac{10}{21}\text{ of }504+\frac{6}{11}\text{ of }352\right)$ p
$=(384+384+192)$ p $=$ Rs 5

33 Req^{d} value $=\left(\frac{7}{5}\text{ of }\frac{1}{14}\text{ of }120-\frac{1}{5}\text{ of }\frac{5}{4}\text{ of }24+\frac{7}{11}\text{ of }462\right)$ pence
$=(12-18+126)$ pence $=10s$

EXAMPLES VI b Page 128

22 Fraction $=\dfrac{23\frac{1}{2}\text{ a}}{31\text{ a}}=\dfrac{93}{4\times31}=\frac{3}{4}$ 24 Fraction $=\dfrac{476\text{ cm}}{544\text{ cm}}=\frac{7}{8}$

26 Fraction $=\dfrac{323\text{ sq ft}}{68\times9\text{ sq ft}}=\dfrac{17\times19}{17\times4\times9}=\frac{19}{36}$

27 Fraction $=\dfrac{\frac{3}{7}\text{ of }37\frac{1}{2}s}{\frac{4}{9}\text{ of }135s}=\dfrac{\frac{3}{7}\text{ of }\frac{75}{2}}{\frac{4}{9}\text{ of }\frac{135}{1}}=\left(\dfrac{3\times75}{5\times2}\right)-\left(\dfrac{4\times135}{9\times1}\right)$
$=\dfrac{3\times75\times9}{5\times2\times4\times135}=\frac{9}{8}$

31 Fraction $=\dfrac{2244\text{ yds}}{2\times1760\text{ yds}}=\frac{561}{880}$

32 See Art 137 We have $\dfrac{4d}{5\frac{3}{4}d}=\frac{16}{23}$ Also $\dfrac{5\text{ yds }1\text{ ft}}{7\text{ yds }2\text{ ft}}=\dfrac{16\text{ ft}}{23\text{ ft}}=\frac{16}{23}$

33 From Art 137 $\dfrac{x\text{ lbs}}{28\text{ lbs}}=\dfrac{5\frac{1}{2}\text{ a}}{73\frac{1}{2}\text{ a}}$, or $\dfrac{x}{28}=\dfrac{21}{294}$,
whence $x=\frac{21}{294}\times28=2$

34 A saves $\frac{2}{5}$ of Rs 2000, or Rs 800 per annum
B saves $\frac{3}{8}$ of Rs 1440, or Rs 540 per annum
$$\text{Req}^{d}\text{ ratio}=\frac{\text{Rs }800}{\text{Rs }540}=\frac{40}{27}$$

35 Rem^{r} $=\frac{1}{11}$ of $\frac{5}{9}$ of £15 $-\frac{7}{15}$ of a guinea
$=\left(\frac{1}{11}\text{ of }\frac{5}{9}\text{ of }300-\frac{7}{15}\text{ of }21\right)$ shillings
$=\left(\frac{125}{9}-\frac{49}{5}\right)$ shillings $=\frac{184}{45}s$
$$\text{Req}^{d}\text{ fraction}=\frac{\frac{184}{45}s}{£3\ 9s}=\frac{\frac{184}{45}s}{69s}=\frac{184}{45\times69}=\frac{8}{135}$$

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7 Since 6 % are cherry trees, 94 % are trees of other kinds,

$$\text{req}^{\text{d}}\ \text{number} = \tfrac{94}{100}\ \text{of}\ 350 = 329$$

9 Let r = the rate per cent, then $\frac{r}{100} = \frac{15}{20}$, and $r = 5$

10 Let r be the req$^{\text{d}}$ percentage He saves Rs 2400,

$$\frac{r}{100} = \frac{2400}{7500}, \text{ and } r = 32$$

12 Let x be the req$^{\text{d}}$ number, then $\frac{75}{100}$ of $x = 1603$,

whence $x = 1603 \times \frac{100}{75} = 4580$

15 If Rs r be the req$^{\text{d}}$ price, then $\frac{6\frac{1}{4}}{100}$ of $x = 930\frac{3}{4}$,

$$r = 930\tfrac{3}{4} \times \frac{100}{6\frac{1}{4}} = 14892$$

16 Since $6\frac{1}{2}$ % are lost, $93\frac{1}{2}$ % are left fit for service

If x be original number, then $\frac{93\frac{1}{2}}{100}$ of $x = 13132$,

$$x = 13132 \times \frac{100}{93\frac{1}{2}} = 14070$$

17 If £x be the income, then the deficit is $\frac{£7\frac{1}{2}x}{100}$

But this is the difference between the expenses and the income

or £$(4837\frac{1}{2} - x)$, $\frac{7\frac{1}{2}}{100}x = 1837\frac{1}{2} - x$, $x + \frac{7\frac{1}{2}x}{100} = 4837\frac{1}{2}$

or $\frac{107\frac{1}{2}x}{100} = 4837\frac{1}{2}$, whence $x = 4837\frac{1}{2} \times \frac{100}{107\frac{1}{2}} = 4500$

19 The Welsh boys $= (100 - 45 - 20 - 13)\,\% = 22\,\%$ of req$^{\text{d}}$ number

If this be x, then $\frac{22x}{100} = 44$, $x = 44 \times \frac{100}{22} = 200$

20 He takes off 3a 9p If x be the req$^{\text{d}}$ amount per cent,

$$\frac{x}{100} = \frac{3\text{a } 9\text{p}}{\text{Re } 1\ 15\text{a } 3\text{p}}, \text{ or } \frac{x}{100} = \frac{45\text{p}}{375\text{p}} \text{ and } x = 12$$

EXAMPLES VI e Page 134.

8 Re 1 5a 4p = Rs $1\frac{1}{3}$

9 £3 2s 6d = £$3\frac{1}{8}$

10 £4 1s 3d = £$4\frac{1}{16}$

11 Re 1 12a = Rs 2 − Re $\frac{1}{4}$

12 Rs 2 14a = Rs $(3-\frac{1}{8})$

14 10a 8p = Re $(1-\frac{1}{3})$

15

	Rs	a	p
	425	0	0
8a = $\frac{1}{4}$ of Re 1	212	8	0
2a = $\frac{1}{4}$ of 8a	53	2	0

16

	Rs	a	p
	960	0	0
2a = $\frac{1}{8}$ of Re 1	120	0	0
3p = $\frac{1}{5}$ of 2a	15	0	0

17

	Rs	a	p
	324	0	0
5a 4p = $\frac{1}{3}$ of Re 1	108	0	0
4a = $\frac{1}{4}$ of Re 1	81	0	0

18

	Rs	a	p
	357	0	0
			2
	714	0	0
5a 4p = $\frac{1}{3}$ of Re 1	119	0	0
1a 4p = $\frac{1}{4}$ of 5a 4p	29	12	0

19

	£	s	d
	464	0	0
			4
	1856	0	0
5s = $\frac{1}{4}$ of £1	116	0	0
1s 3d = $\frac{1}{4}$ of 5s	29	0	0

20

	£	s	d
	425	0	0
			3
	1275	0	0
10s = $\frac{1}{2}$ of £1	212	10	0
1s 8d = $\frac{1}{6}$ of 10s	35	8	4

22

	Rs	a	p
	723	0	0
			3
	2169	0	0
8a = $\frac{1}{2}$ of Re 1	361	8	0
2a = $\frac{1}{4}$ of 8a	90	6	0
1a = $\frac{1}{2}$ of 2a	45	3	0

24

	Rs	a	p
	355	0	0
			3
	1065	0	0
8a = $\frac{1}{2}$ of Re 1	177	8	0
5a 4p = $\frac{1}{3}$ of Re 1	118	5	4

25

	£	s	d
	632	0	0
10s = $\frac{1}{2}$ of £1	316	0	0
2s = $\frac{1}{5}$ of 10s	63	4	0
6d = $\frac{1}{4}$ of 2s	15	16	0
2d = $\frac{1}{3}$ of 6d	5	5	4
1d = $\frac{1}{4}$ of 2d	1	6	4

26

	£	s	d
	6113	0	0
5s = $\frac{1}{4}$ of £1	1528	5	0
2s = $\frac{1}{10}$ of £1	611	6	0
1s = $\frac{1}{2}$ of 2s	305	13	0
1d = $\frac{1}{12}$ of 1s	25	9	5
$\frac{1}{2}$d = $\frac{1}{2}$ of 1d	12	14	$8\frac{1}{2}$

27

	Rs	a	p
	427	0	0
			6
	2562	0	0
5 a 4 p = $\frac{1}{3}$ of Re 1	142	5	4
1 a 4 p = $\frac{1}{4}$ of 5 a 4 p	35	9	4
1 p = $\frac{1}{16}$ of 1 a 4 p	2	3	7

28

	Rs	a	p
	288	0	0
			3
	864	0	0
8 a = $\frac{1}{2}$ of Re 1	144	0	0
4 a = $\frac{1}{2}$ of 8 a	72	0	0
3 p = $\frac{1}{16}$ of 4 a	4	8	0

29

	£	s	d
	6184	0	0
			5
	30920	0	0
5s = $\frac{1}{4}$ of £1	1546	0	0
2s = $\frac{1}{10}$ of £1	618	8	0
3d = $\frac{1}{8}$ of 2s	77	6	0

30

	£	s	d
	1260	0	0
5s = $\frac{1}{4}$ of £1	315	0	0
2s 6d = $\frac{1}{2}$ of 5s	157	10	0
1s 3d = $\frac{1}{2}$ of 2s 6d	78	15	0
2½d = $\frac{1}{6}$ of 1s 3d	13	2	6

MISCELLANEOUS EXAMPLES II Page 135

6 He sells $\frac{195}{1\frac{1}{2}}$ lbs , he adds $\left(\frac{195\times 2}{3}-112\right)$ lbs

10 If x be the req^{d} no , then Rs $24\frac{7}{16}\times\frac{x}{2}$+Rs $26\frac{5}{16}\times\frac{x}{2}$

$$=\text{Rs } 25\times x+\text{Rs } 15$$

11 Let x be the req^{d} number , then $\frac{1}{25}x=36084$,

$$x=36084\times 25=\frac{3608400}{4}=902100$$

14 The total wages in the req^{d} time must be an exact multiple both of 10s 6d and 16s 4d, i e of 126d and 196d The L C M. of 126d and 196d, or $(14\times 14\times 9)d$, will therefore be the total wages earned in the req^{d} time

This will take $\frac{14\times 14\times 9}{196}$ weeks, or 9 weeks to earn

15 Train travels $35\times 1760\times 3$ ft in 60×60 secs

16 If Rs x be req^{d} sum, then $\frac{3x}{5}+\frac{4x}{25}+750=x$

17

	£	s	d
	1746	0	0
			14
	24444	0	0
5s = $\frac{1}{4}$ of £1	436	10	0
1s 3d = $\frac{1}{4}$ of 5s	109	2	6
7½d = $\frac{1}{2}$ of 1s 3d	54	11	3

20 The train travels $\frac{24\times1760}{60}$ yds or 1584 yds in 1 min
the number of spaces, each equal to 66 yds, passed over in 1 min will be $\frac{1584}{66}$ or 24 *If at the beginning of the minute the traveller is opposite a post*, he will count that post as 1, and will afterwards count 24 more posts in 1584 yds In any other case he will count 24
Thus 25 is the greatest number and 24 the least
[The student should draw a diagram]

22 From Art 97, L C M $=\frac{A\ B}{X}$, *i e* $9100=\frac{260B}{65}$

26 (i) $237160=2^3\ 5^1\ 7^2\ 11^2$
(ii) $66825=3^2\ 5^2\ 11$ Thus (i) and (iii) are perfect squares.
(iii) $571536=2^4\ 3^6\ 7^2$
The sq root of (i) is $2^2\ 5\ 7\ 11$, of (iii) is $2^2\ 3^3\ 7$
Hence H C F $=2^2\ 7$ or 28, L C M $=2^4\ 3^6\ 5\ 7\ 11$ or 11880

29 21 posts have 20 spaces of 11 yds each between them,
the train travels 11×20 yds or $\frac{1}{3}$ mi per 1 min,
its speed is 30 mi per hour

33 Since $\frac{5}{8}$ mi $=1$ Km, $\frac{5}{8}\times1760$ yds or 1100 yds $=1000$ m,
100 yds $=\frac{1000}{1100}$ m $=91$ m (nearly).

34 Since the length and breadth must divide 72 and 57 exactly, both length and breadth must be equal to the H C F of 72 and 57, *i e* 3 ft
area req^d $=(3\times3)$ sq ft, *i e* 1 sq yd

35 By the method of Art 82 we find
the number $=2^7\ 3^2\ 7\ 31=(2^4\ 31)\times(3^2\ 7)\times2^3-62\times63\times64$

37 (i) Exp^n $=2\frac{7}{8}+(1\frac{1}{4})+5\frac{3}{7}+(1\frac{3}{14})=2\frac{7}{8}+(1-\frac{3}{4})+5\frac{3}{7}+(1-\frac{1}{14})$
$=9+(\frac{7}{8}-\frac{3}{4})+(\frac{3}{7}-\frac{1}{14})=9+\frac{1}{8}+\frac{5}{14}=9\frac{5}{7}+\frac{5}{14}=10\frac{1}{2}$
(ii) Exp^n $=1+\frac{1}{10}-\frac{1}{10}-(\frac{1}{11}-\frac{1}{11})=1+\frac{1}{10}-\frac{1}{11}=1+\frac{11-10}{10\times11}=1\frac{1}{110}$

39 11 tons $=(11\times2240)$ lbs $=\left(\frac{11\times2240}{7}\right)$ sts
$=(\frac{11}{7}\times\frac{11\times2240}{40})$ mds $=299\frac{1}{7}$ mds

42 Number $=$(L C M of 15, 35, 42)$+6$

45 Req^d value $=$ Rs $33\frac{1}{3}\times\frac{51}{100}=$ Rs $\frac{100}{3}\times\frac{51}{100}=$ Rs 25×17

46 Req^{d} number $=\frac{18\times 8}{82\frac{2}{7}}=1\frac{3}{4}$

47. Each fraction is greater than $\frac{1}{2}$,
then sum is greater than $\frac{1}{2}\times 4$ or 2
For the second part of the question, we find by method of Art 113 the two fractions to be $\frac{17}{25}$ and $\frac{29}{40}$
Req^{d} difference $=\frac{17}{25}-\frac{29}{40}=\frac{136-125}{200}=\frac{11}{200}$

49 Fraction $=\frac{\frac{1}{15}\text{ of }20-\frac{1}{14}\text{ of }21}{2\frac{1}{2}}=(\frac{4}{3}-\frac{3}{2})\times\frac{2}{5}=\frac{8}{3}-\frac{6}{5}=\frac{1}{15}$

52 Cost at pit's mouth $=5\text{a}\times 230=\text{Rs }71\ 14\text{a}$
Cost at pit's mouth + carriage for 60 miles $=\text{Rs }143\ 12\text{a}$
carriage for 60 mi $=\text{Rs }143\ 12\text{a}-\text{Rs }71\ 14\text{a}$
$=\text{Rs }71\ 14\text{a}$ for 230 mds,
hence carriage per md per mile $=\frac{1150\text{a}}{230\times 60}$
$=\frac{1150\times 12}{230\times 60}\text{p}=1\text{p}$

54 See Art 130

55 Walking to and riding from he takes $3\frac{3}{4}$ hrs
Riding to and riding from he takes $2\frac{1}{2}$ hrs
by riding one way instead of walking he saves $1\frac{1}{4}$ hrs,
and by riding both ways instead of walking he would save $2\frac{1}{2}$ hrs
he would walk both ways in $(2\frac{1}{2}+2\frac{1}{2})$ or 5 hrs

57 (i) 1 yd 2 ft 3 in $=63$ in req^{d} value $=63\text{ in}\times\frac{25}{7}$
$=225\text{ in}=6\text{ yds }9\text{ in}$
(ii) Req^{d} value $=\text{Rs }8\ 7\text{a }4\text{p}\times(10-\frac{1}{8})$
$=\text{Rs }84\ 9\text{a }4\text{p}-\text{Re }1\ 0\text{a }11\text{p}$

58 The first remainder is $\frac{2}{3}$, the second is $\frac{3}{4}$ of $\frac{2}{3}$ or $\frac{1}{2}$
if I had Rs x at first, $(1-\frac{1}{3}-\frac{1}{4}\text{ of }\frac{2}{3}-\frac{1}{5}\text{ of }\frac{1}{2})x=100$

59 £3 7s $10\frac{1}{2}$d $=1629$ halfpence, £1 $=480$ halfpence
The least sum of money whose value can be reckoned exactly in gold or in sovereigns, will be the L C M of 1629 halfpence and 480 halfpence This is $(160\times 543\times 3)$ halfpence, or (160×1629) halfpence, and would require 160 or of gold

60 Req^{d} diff $= \frac{5}{48}$ of £3 $- \frac{3}{14}$ of 17s 6d $= (\frac{5}{48}$ of $120 - \frac{3}{14}$ of $35)$ sixpences
$= (12\frac{1}{2} - 7\frac{1}{2})$ sixpences $= 2s$ 6d

63 If a gallery ticket cost x rupees, then
$$50x + 30(x+2) + 20(x+3) = 16 \times 20$$

64. (ii) Fraction $= \dfrac{1\frac{2}{16} + 6\frac{3}{4}}{5\frac{1}{6} - \frac{5}{6}}$ Multiply numerator and denominator by 36

66 (i) No of metres $= \dfrac{84 \times 12}{39\frac{3}{8}} = \dfrac{84 \times 12 \times 8}{315} = 25\frac{3}{5}$

(ii) No of cwt $= \dfrac{280 \times \frac{11}{5}}{112} = \dfrac{280 \times 11}{112 \times 5} = 5\frac{1}{2}$

(iii) 9 gals $= (9 \times 8)$ pints $= \dfrac{9 \times 8}{1\frac{3}{4}}$ litres $= 41\frac{1}{7}$ litres

(iv) 2 tons 4 cwt $= 2\frac{1}{5}$ tons $= 2\frac{1}{5} \times 2240$ lbs
$$= \frac{2\frac{1}{5} \times 2240}{2\frac{1}{5}} \text{ Kg} = 2240 \text{ Kg}$$

67 (i) Fraction $= \dfrac{315 \text{ p}}{855 \text{ p}} = \frac{7}{19}$ (ii) Fraction $= \dfrac{77\frac{1}{2} \text{ n}}{87\frac{1}{2} \text{ n}} = \frac{31}{35}$

68 (i) Exp^{n} $= 7 + \frac{7+2+9}{1} + \frac{14+11}{18} = 8\frac{1}{2} + 1\frac{7}{18} = 9\frac{16}{18} = 9\frac{8}{9}$
(ii) Exp^{n} $= \frac{18}{3} \frac{-7}{7} + \frac{27-16-1}{36} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$

69 1 lit $= 1\frac{3}{4}$ pts $= (1\frac{3}{4} \times 2)$ tumblers $= \left(\dfrac{1\frac{3}{4} \times 2}{\frac{5}{6}}\right)$ teacups, or $5\frac{5}{6}$ teacups
5 teacups can be exactly filled Now $\frac{5}{6}$ teacup is left
This $= \left(\frac{5}{6} \times \dfrac{1}{5\frac{5}{6}}\right)$ litre or $\frac{1}{7}$ litre

70 40 Km per hr $= 40 \times \frac{5}{8}$, or 25 mi per hr, $i.e.$ 5 mi in $12\frac{1}{2}$ min

71 3 ac 2 r 20 p $= 3\frac{3}{8}$ ac 1 sq mi $= 640$ ac
Req^{d} no $= (\frac{27}{8} \times 7 \times 640) - 3\frac{5}{8}$

72 1 Kg costs $\dfrac{51\frac{1}{2}s}{20}$,

1 lb costs $\dfrac{51\frac{1}{2}s}{20 \times 2\frac{1}{5}}$ and 1 cwt costs $\dfrac{51\frac{1}{2}s}{20 \times 2\frac{1}{5}} \times 112$

73 Exp^{n} $= \dfrac{15}{20} - \dfrac{7\frac{1}{2}}{15} = \frac{3}{4} - \frac{1}{2} = \frac{1}{4}$

74. Let $9x$ miles be the distance by sea, then $3x$ miles and x miles are the distances by rail and coach respectively,

$$9x+3x+x=520, \text{ whence } x=40$$

Cost by coach $=9\text{p}\times40=360\text{p}$, cost by rail $=4\text{p}\times120=480\text{p}$

Cost by sea $=2\text{p}\times360=720\text{p}$,

total cost $=(360+480+720)\text{p}=1560\text{p}$,

hence average cost per mile for whole journey $=\dfrac{1560\text{p}}{520}=3\text{p}$

75. 55 Kg $=(55\times2\frac{1}{5})$ lbs $=121$ lbs. cask holds $(121-11)$ lbs or 110 lbs of water, *i e* $\frac{110}{10}$ gals or 11 gals of water

76 2 tons on 1 ac $=2\times2240$ lbs on 4840 sq yds

$$=\frac{2\times2240}{2\frac{1}{5}}\text{ Kg on }4840\times36^2\text{ sq in}$$

$$=\frac{2\times2240}{2\frac{1}{5}}\times1000\text{ gm on }\frac{4840\times36^2}{(39\frac{3}{8})^2}\text{ sq m}$$

This gives $\dfrac{2\times2240\times1000\times39\frac{3}{8}\times39\frac{3}{8}}{2\frac{1}{5}\times4840\times36\times36}$ gm on 1 sq m

This fraction $=\dfrac{5\times2\times2240\times1000\times315\times315}{11\times4840\times8\times8\times36\times36}=\dfrac{10\times35\times100\times35\times35}{11\times484\times4\times4}$

$$=\frac{4287000}{85184}=503 \text{ to nearest integer}$$

77. $\frac{7}{10}=\frac{4}{10}+\frac{2}{10}+\frac{1}{10}=\frac{1}{4}+\frac{1}{8}+\frac{1}{20}$ of $\frac{1}{8}=\frac{1}{4}+\frac{1}{20}$ of $\frac{1}{4}+\frac{1}{20}$ of $(\frac{1}{20}$ of $\frac{1}{4})$

For second part of question we have $\frac{2}{20}$ of $2\frac{2}{3}=\frac{1}{30}$

we have to multiply £33 2*s* 8*d* by $\frac{8}{10}$ or $5\frac{7}{10}$

Req^{d} value $=$£33 2*s* 8*d* $\times5\frac{7}{10}$

$=$£33 2*s* 8*d* $\times[5+\frac{1}{4}+\frac{1}{20}$ of $\frac{1}{4}+\frac{1}{20}$ of $(\frac{1}{20}$ of $\frac{1}{4})]$

$=$£165 13*s* 4*d* $+$£8 5*s* 8*d* $+$£4 2*s* 10*d* $+$£2 1*s* 5*d* $=$£180 3*s* 3*d*

78 50 Km $=50\times\frac{5}{8}$ mi $=31\frac{1}{4}$ mi

the slower train is $1\frac{1}{4}$ mi behind in 1 hr,

i e it will be 5 mi behind in 4 hrs

EXAMPLES VII a Page 143

3 1 sheep will cost £18 $\times\frac{1}{8}$ **4** 1 man will take 9 days $\times10$

7 1 cwt should be carried 30 mi $\times7$, 10 cwt should be carried 30 mi $\times\frac{7}{10}$

9 I pay (i) Rs $12\times\frac{1}{8}$ for 1 lb, (ii) Rs $12\times\frac{6}{8}$ for 6 lbs,

(iii) Rs $12\times\frac{x}{8}$ for x lbs

10 1 lb costs Rs $15 \times \frac{1}{x}$, y lbs cost Rs $15 \times \frac{y}{x}$

11 £68 will be earned in 12 wks $\times \frac{\text{r}}{\text{5}}\frac{8}{1}$

13 In 100 days 125 men $\times \frac{1}{1}\frac{2}{0}\frac{5}{0}$ are wanted

14 35 horses will eat it in 14 days $\times \frac{2}{1}\frac{0}{5}$

17 At 24 Km an hour I should take 16 hrs $\times \frac{2}{2}\frac{0}{4}$

20 5 loads would bring $15\frac{3}{5}$ tons $\times \frac{5}{1}\frac{}{3}$

21 In 43 wks I should save Rs $62\frac{7}{1}\frac{}{0} \times \frac{4}{3}\frac{3}{7}$

23 (ii) x men would take p hrs $\times \frac{x}{y}$

24 (i) Req^{d} distance $= 13\frac{1}{2} \times \frac{8}{3}$ mi (ii) Req^{d} distance $= m$ miles $\times \frac{x}{p}$

25 In 17 min it will travel 30 mi $\times \frac{1}{6}\frac{7}{0}$ In x min it will travel 30 mi $\times \frac{x}{60}$

26 Req^{d} speed = (i) $1\frac{0}{1}\frac{\text{r}}{7}\frac{6}{0}$ mi $\times 60$ per hr (ii) $\frac{a}{1760}$ mi $\times 60$ per hr

27 (i) Req^{d} distance $= (90 \times 1760 \times 3)$ ft $\times \frac{1}{60 \times 60}$ per sec
(ii) Req^{d} speed $= (m \times 1760)$ yds $\times \frac{1}{60}$ per min

28 Req^{d} time = (i) $\frac{3}{4}$ min $\times \frac{6}{1}\frac{0}{0}$, (ii) a min $\times \frac{x}{y}$

35 It loses 133 min $\times \frac{3}{2}\frac{6}{4 \times 7}$ 37 Req^{d} time = 55 months $\times \frac{4}{7}\frac{9}{0}$

40 Req^{d} time = 42 days $\times \frac{4000}{4000-1760}$

EXAMPLES VII b Page 146

1 The whole $= \frac{8}{8} = \frac{8}{7}$ of $\frac{7}{8} = \frac{8}{7}$ of Rs 930

3 The whole $= \frac{\text{r}}{\text{r}} = \frac{7}{6}$ of $\frac{6}{7} = \frac{\text{r}}{6}$ of 54 in $= 63$ in

4 $(1 - \frac{1}{2}\frac{\text{r}}{0})$ or $\frac{7}{2}\frac{}{0}$ of journey $= 6$ mi, $\frac{1}{2}\frac{\text{r}}{0} = \frac{1}{3}\frac{7}{}$ of $\frac{3}{2}\frac{}{0} = \frac{1}{3}\frac{\text{r}}{}$ of 6 mi $= 34$ mi

5 $\frac{2}{7}$ of inc $= \frac{2}{7}$ of $\frac{5}{4}$ of $\frac{4}{6}$ of inc $= \frac{2}{7}$ of $\frac{\text{r}}{4}$ of Rs 3080 = Rs 1100

6 and 7 As No 5 8 Req^{d} part $= \frac{\text{r}}{1}\frac{}{3} \times \frac{6}{2}\frac{\text{r}}{7}\frac{0}{0}$ 9 As No 8

10 1 Km $= \frac{\text{r}}{8}$ mi and costs $\frac{\text{r}}{8}$ of Rs 2400, or Rs 1500

11 1 mi $= \frac{8}{5}$ Km and costs $\frac{8}{5}$ of Rs $311\frac{1}{4}$, or Rs 498

12 1 lb $= \frac{5}{1}\frac{}{\text{r}}$ Kg and costs $\frac{\text{r}}{1}\frac{}{1}$ of $44d$, or $1s\ 8d$

13 1 lb costs $\frac{1}{16}$ of 110d or $1\frac{3}{4}d$
1 Kg, or $2\frac{1}{2}$ lbs costs $1\frac{3}{4}d \times 2\frac{1}{2}$, or $2\frac{3}{4}d$

14 1 lit $= \frac{5}{4}$ pts $= \frac{5}{4}$ of $\frac{1}{8}$ gal, and costs $\frac{5}{4}$ of $\frac{1}{8}$ of 40d, or $8\frac{3}{4}d$

19 We have to find which is the greater, 96 Km per hr, or 60 mi an hr
Since 60 mi $= 60 \times \frac{8}{5}$ Km $= 96$ Km, they are approx^{ly} equal

20 A speed of 119 mi in $2\frac{1}{2}$ hrs $=$ a speed of $119 \times \frac{8}{5}$ Km in $\frac{5}{2}$ hrs
$=$ a speed of $119 \times \frac{8}{5}$ Km $\times \frac{2}{5}$ in 1 hr

23 56a buy 36 m, 56a buy $\frac{36}{39\frac{3}{8}}$ m or $\frac{32}{35}$ m,
hence Rs 30 10a or 190a buy $\frac{32}{35}$ m $\times \frac{190}{5}$, i.e. 8 metres

24 $8\frac{3}{4}$a per 1 m $= 8\frac{3}{4}$a per $\frac{39\frac{3}{8}}{36}$ yds $= \frac{35}{4}$a per $\frac{35}{32}$ yds,
i.e. 8a per 1 yd gain on 1 yd is $\frac{1}{4}$a, and gain on 48 yds is Re 1 8a

26 Corn land $= (1 - \frac{1}{10})$, or $\frac{9}{10}$ of acreage
the whole $= \frac{1}{1}\frac{0}{3} = \frac{1}{13}$ of $\frac{9}{10} = \frac{1}{13}$ of 216 acres $= 468$ acres

27 $(1 - \frac{1}{16})$, or $\frac{15}{16}$ of battalion $= 715$ men,
815 men are $\frac{15}{16} \times \frac{816}{715}$ of battalion, or $\frac{3}{4}$ of battalion,
hence req^{d} fraction $= \frac{3}{4}$

28 $(1 - \frac{5}{8} - \frac{1}{16})$, or $\frac{1}{16}$ of journey $= 8$ mi, whole journey $= 128$ mi

29 Master's share $= (1 - \frac{1}{3} - \frac{1}{4} - \frac{1}{5})$, or $\frac{13}{60}$ of vessel
Whole vessel $= \frac{60}{13} = \frac{60}{1}$ of $\frac{13}{60}$ and is worth $\frac{60}{13}$ of Rs $5858\frac{1}{8}$,
or Rs 27037 8a

30 $(1 - \frac{1}{10} - \frac{1}{15})$, or $\frac{19}{30}$ of inc. $=$ Rs $4927\frac{1}{2}$,
total income $= \frac{60}{60} = \frac{60}{19}$ of $\frac{19}{60} = \frac{60}{19}$ of Rs $1927\frac{1}{2}$
$=$ Rs $\frac{60 \times 7885}{4 \times 10} =$ Rs $\frac{23655}{4} =$ Rs 6033 12a

EXAMPLES VIII g Page 163

27 See Art 5

Km	
90 00	
15 26	
73 50	
0 74	
0 50 $=$ 500 m	

29 See Art 5

yds	
100	
14 2	
17 4	
3 5	
64 9	

error $= 0.1$ yd $= 3.6$ in

30 Perimeter $=(4\,64+5\,02+6\,7)$ in $=16\,36$ in
req^{d} error $=0\,06$ in, shewing $16\,4$ in to be a nearer estimate

33 $1\,93-2\,4=-(2\,4-1\,93)=-0\,47$

36 Exp$^{n}=5\,99-6=-(6-5\,99)=-0\,01$

40 Transposing $v=16\,821-(4\,04+11\,4+0\,291)=1\,09$

43
$$\begin{array}{r} 3\,92 \\ 14 \\ 0\,876 \\ 5\,61 \\ 0\,0003 \\ 1\,4037 \\ \hline 25\,81 \end{array}$$
$=26$ correct to nearest unit

EXAMPLES VIII k Page 168

7 To multiply $86\,54$ by $2\,37$, add the results of (i), (ii) and (iii)

17 1 yd $=2\,54$ cm $\times 36=91\,44$ cm $=0\,9144$ m

26 $16\times 2\,5=40$, $\quad 1\,6\times 0\,25=(16\times 2\,5)-100=0\,4$
Also $160\times 0\,025=16\times 2\,5\times 10-100=4$

31 2 Km 375 m $=2\,375$ Km, 1 Km 800 m $=1\,8$ Km

$$\begin{array}{r} 2\,375 \\ 1\,8 \\ \hline 2\,375 \\ 1\,9000 \\ \hline 4\,275 \end{array}$$
Area $=4\,275$ sq Km

32 Area $=(4\,6)^{2}$ sq in $=21\,16$ sq in,
total pressure $=(21\,16\times 15)$ lbs $=317\,4$ lbs

35 (i)
$$\begin{array}{r} 3\,1416 \\ 28 \\ \hline 62\,832 \\ 25\,1328 \\ \hline 87\,9648 \end{array}$$
i e $87\,9$ in

(ii)
$$\begin{array}{r} 3\,1416 \\ 450 \\ \hline 1256\,64 \\ 157\,08 \\ \hline 1413\,72 \end{array}$$
i e 1414 ft

(iii) $3\,1416\times 15\times 40$
$=3\,1416\times 600$
$=314\,16\times 6=1884\,96$
i e 1885 ft

37 Req^{d} w$^{t}=(0\,28\times 1000\times 13\,5)$ gm $=(28\times 135)$ gm $=3780$ gm

39. 5 cu m $=(5\times 1000\times 1000)$ cu cm
This weighs $(5000\times 1\,15)$ Kg, or (50×115) Kg, or 5750 Kg

41 Value $=0\,0875\times 40=3\,5$

42 1 25
3 2
3 75 $4 \times 2\,375 = 9\,5$
0 250
4·000

43 Value $= 0\,04 \times 0\,125 \times 200 = 8 \times 0\,125 = 1$

44. Value $= 1\,625 \times 0\,16 \times 0\,5 = 1\,625 \times 0\,08 = 0\,13$

EXAMPLES VIII l. Page 171

20 Each share $= £\frac{4\,8}{8} = £0\,6 = 6$ tenths of £1 $= 12s$

21–49 See Art 167

52 Circumference $= \frac{1001}{400}$ yds $= \frac{1001 \times 36}{400}$ in $= \frac{9009}{100}$ in $= 90\,09$ in
This $= 90\,1$ in (to nearest tenth) and error $= 0{\cdot}01$ in

57 $\frac{8\,6}{9} = 0\,95555\ldots = 0\,9556$ correct to 4 decimal places

65
$$135 \left\{ \begin{array}{c|l} 5 & 9\,046 \\ 9 & 1\,8092 \\ 3 & 0\,2010 \\ \hline & 0\,0670 \end{array} \right.$$
giving 0 067

66
$$385 \left\{ \begin{array}{c|l} 5 & 349\,968 \\ 11 & 69\,9936 \\ 7 & 6\,3630 \\ \hline & 0\,9090 \end{array} \right.$$
giving 0 909

EXAMPLES VIII m Page 174

19 $\frac{30\,26}{89} = \frac{3\,026}{8\,9} = 0\,34$ $\qquad \frac{302\,6}{8\,9} = \frac{30\,26 \times 10}{89 - 10} = \frac{30\,26}{89} \times 100 = 34$

$$8{\cdot}9 \overline{)\,3\,026}\ \begin{array}{l} 0\,34 \\ \\ 356 \end{array}$$

Also $\frac{3\,026}{890} = \frac{30\,26 - 10}{89 \times 10} = \frac{30\,26}{89} - 100 = 0{\cdot}0034$

22 (iv) $v = 4\,8 \times \frac{3\,r}{5} = 4\,8 \times \frac{5}{4} = 6$

23
$$5\,65 \overline{)\,1210}\ \begin{array}{l} 214 \\ \\ 800 \\ 2350 \\ 90 \end{array}$$
remainder $= 90c$

29 Exp^n $= 7\,2 \times \frac{8\,4}{6\,6} = 7\,2 \times \frac{7}{5} = 10\,8$

31 Exp^n $= \dfrac{0\,017}{0\,34 \times 0\,25} = \dfrac{0\,017 \times 4}{0\,34} = \dfrac{0\,004}{0\,02} = 0\,2$

35 $\dfrac{0\,08571}{25\,603} = \dfrac{0\,008571}{2\,5603} = 0\,0033$

$$2\,5603 \overline{)\,0\,0085710\,(\,0\,00334}$$
$$89010$$
$$12201$$

40 (i) diameter $= \dfrac{49\,6 \text{ in}}{3\,1416} = 15\,8 \text{ in}$

$$3\,1416 \overline{)\,49\,6\,(\,15\,78}$$
$$18\,1840$$
$$2\,47600$$
$$27688$$

(ii) diameter $= \dfrac{1760 \times 3 \text{ ft}}{500 \times 3\,1416} = \dfrac{3520 \times 36 \text{ in}}{1000 \times 3\,1416}$

$= \dfrac{3\,52 \times 3 \text{ in}}{0\,2618} = \dfrac{10\,56}{0\,2618} \text{ in} = 40\,34 \text{ in}$

$$2\,618 \overline{)\,10560\,(\,40\,336}$$
$$8800$$
$$9460$$
$$16060$$

41 $\dfrac{19}{0\,42} = \dfrac{190}{4\,2} = 45\frac{1}{4\,2} = 45\frac{0\,1}{0\,42}$ rem^r $= 0\,1$ in

42 (iii) $\dfrac{37\,8241}{293} = \dfrac{0\,378241}{2\,93}$

$= 0\,1290\frac{0\,000271}{2\,93} = 0\,1290\frac{0\,0271}{293}$

rem^r $= 0\,0271$

$$2\,93 \overline{)\,0\,378241\,(\,0\,1290}$$
$$852$$
$$2664$$
$$271$$

(iv) $\dfrac{37\,8241}{90\,7} = \dfrac{3\,78241}{9\,07}$

$= 0\,417\frac{0\,00022}{9\,07} = 0\,417\frac{0\,0022}{90\,7}$

rem^r $= 0\,0022$

$$9\,07 \overline{)\,3\,78241\,(\,0\,417}$$
$$1544$$
$$6371$$
$$22$$

EXAMPLES VIII *n.* *Page* 179

30. $$23 \overline{)\,110\,(\,0\,478}$$
$$180$$
$$190$$
$$6$$

$\frac{11}{23} = 0\,478\frac{6}{23} = 0\,478$

48 $0\,03125 = 0{\cdot}03\frac{1}{8} = \frac{3\frac{1}{8}}{100} = \frac{25}{800} = \frac{1}{32}$

49 $0\,071875 = 0\,071\frac{7}{8} = \frac{71\frac{7}{8}}{1000} = \frac{575}{8000} = \frac{23}{320}$

50 (i) $\frac{3}{5^2} = \frac{3 \times 2^2}{10} = \frac{12}{100} = 0\,12$, (iii) $\frac{7}{5^3 \times 2^2} = \frac{7 \times 2^3}{10^3 \times 2^2} = \frac{14}{1000} = 0\,014$

EXAMPLES IX a Page 181

23
12 | 9 p
16 | 8 75 a.
0 546875 Re

24.
12 | 9 p
16 | 7 75 a.
8 484375 Rs

25
12 | 1 5 p
16 | 8 125 a
5 5078125 Rs

26
12 | 10 5*d*
20 | 13 875*s*
11 694£

27
12 | 7 5*d*
20 | 16 625*s*
0 831£

28
12 | 4*d*
20 | 15 3333*s*
8 767£

29
12 | 8 25*d*
20 | 10 6875*s*
2 5344£

30
12 | 5 5*d*
20 | 7 46833*s*
5 3729£

31
12 | 4·25*d*
20 | 5 35416*s*
0 1677£

32
16 | 12 chks
40 | 13 75 srs
5 34375 mds

33
16 | 14 chk
20 | 5 875 cot
4 29375 big

34
3 | 1 5 ft
11 | 5 5 yds
1760 10 | 0 5
16 | 0 05
0 003125 mi

35
4 | 0 25 qr
20 | 3 0625 cwt
5 | 2 153125 tons
0 430625 of 5 tons

36
12 | 9 p
16 | 9 75 a
5 | 19 609375 Rs
5 | 3 921875
0 784375 of Rs 25

EXAMPLES IX b Page 183

13 Rs 3 21875
3 5 ৲
6 0 p

14 Rs 5 1875
3 0 a

15 Rs 9 875
14 0 a

16 Rs 2 078125
1 25 ৲
3 0 p

17. Rs 11 5625
9 0 a

18 Rs 0 40625
6 5 a
6 0 p

19 £4 63
12 6*s*
7 2*d*

20 £5 72
14 4*s*
4 8*d*

21 £14 823
16 46*s*
5 52*d*

22 £9 89
17 8*s*
9 6*d*
2 4*f*

23 £0 634
12 68*s*
8 16*d*
0 64*f*

24 £11 047
0 94*s*
11 28*d*
1 12*f*

25 Re 0 28125
2
Re 0 5625
9 0 ৲

26 Rs 1 578125
4
Rs 6 3125
5 0 a

27 Rs 3 11875
5
Rs 15 59375
9 5 a.
6 0 p

28 Re 0 53125
10
Rs 5 3125
5 0 a

29 Rs 7 304
8
Rs 58 432
6 912 a
10 944 p
Rs 58 6 a 11 p

30 Re 0 78
9
Rs 7·02
0 32 a
3 84 p
Rs 7 0 a 3 p

31 12 | 4 5*d*
20 | 15 375*s*
4 | 3 79875£
0 94218 of £4

32 12 | 4*d*
20 | 9 33333*s*
8 | 7 46666£
0 93333 of £8

33 12 | 8*d*
20 | 17 66666*s*
40 | 15 88333£
0 39708 of £40

34 12 | 9 75*d*
20 | 7 8125*s*
11 390625£
0 008
0 091125 of £125

35 1 8875 mds
35 5 srs
8 0 chks

36 6 475 big
9 5 cot
8 0 chk

37 0 895 day
21 48 hours
28 8 mın
48 secs

38 2 03125 mı
$=2\,03\frac{1}{8}$ mı
$=2\frac{1}{32}$ mı

39 0 0425 md.
10
0 425 md
17 0 srs

40 0 9375
7
6 5625 tons
11 25 cwt
1 0 qr

41 9 9375 of £3 3*s*
$=9\frac{15}{16}$ of £3 3*s*
$=(10-\frac{1}{16})$ of £3 3*s*

42 16 | 12 75 a
Re 0 79687
=Re 0 7969

43 4 | 3 25 r
0 8125 ac
0 4
0 325

44 7 | 5 25 d.
52 | 9 75 wks
5 | 0 1875 yrs
0 0375 of 5 yrs

45 £4 325
6 5*s*

46 £3 072
1 44*s*
5 28*d*
1 12*f*

47 £0 71
14 2*s*
2 4*d*
1 6*f*

48 £0 099872
=£0 1
=2*s*

49 £7 778
15 56*s*
6 72*d*
2 88*f*

50 £0 754
15 08*s*
096 *d*
3 84*f*

51–54 See Arts 178, 179

For 57–60, see Art 179

Thus in Ex 57 we require 0 017 × 640, or 0 17 × 64, and in Ex 58 we require 0 2190 × 1760, or 2 19 × 176

For Ex 59, see Ex 54, and for Ex 60, see Ex 53

EXAMPLES IX d Page 188

25 $24f = 25$ mils, $\quad 1f = \frac{25}{24}$ mils $= \left(1 + \frac{1}{24}\right)$ mils $= £0\,001 \times \left(1 + \frac{1}{24}\right)$

26 By Ex 25, $1f = £0\,001 \times \frac{25}{24} = \frac{£0\,025}{24} = \frac{£0\,00625}{6} = £0\,001042$

1 mil $= £0\,001$ $\quad$ req^{d} diff $= £0\,000042$

37 12 half-cents $=$ Re 0 06
0 96 a
11 52 p
1 req^{d} diff $= 12 - 11\,52 = 0\,48 = \frac{48}{100} = \frac{12}{25}$

38 Rs 2 624 $\times$ 5 = Rs 13 12 $\quad$ Rs 13 12
1 92 a
11 04 p

EXAMPLES X a Page 193

38 (i) Absolute error $= £(37\,5 - 37\,482) = £0\,018$

Relative error $= \frac{0\,018}{37\,482} = \frac{3}{6247} = 0\,00048$

Percentage error If x denote the req^{d} rate per cent

then $\frac{x}{100} = 0\,00048$ and $x = 0\,048$

38 (ii)-44 As No 38 (i)

EXAMPLES X b Page 195

1
41 04	62
0 00	17
21 89	2
62 93	99

2
1 35	64
0 04	02
4 50	19
5 89	85

3
5 08	19
1 66	66
0 03	33
6 78	18

4
0 000	71
0 008	5
0 000	08
0 009	29

5
0 285	71
0 833	33
3 256	14
4 375	18

6
0 3	
0 016	
3 682	82
0 000	99
3 999	81

7
26	09
306	9
0	00
332	99

8
41 6	82
0 1	00
41 5	82

9

37	26
982	8
1020	06
19	9
1000	16

10

0 210	52
0 352	94
0 384	61
0 948	07

11 Expressing each item *in millions*, we have

4 683
0 807
17 493
0 094
23 077

giving as answer 23,100,000

12 Expressing each item *in millions*, we have

0 971
8 792
0 093
17 828
27 684

giving as answer 27,700,000

13 Expressing each item *in millions*, we have

£
65 409
30 814
15 659
28 458
8 474
0 460
0 936
0 675
150 885

giving as answer £150,900,000

14 (i) $x+x^2+x^3$
$=0\,08+0{\cdot}0064+0\,00051$

(ii) $x^4=0\,00004$

15

0 2	
0 04	
0·00	8
0·00	16
0·00	032
0 24	992

This result differs from $\frac{1}{4}$ or 0 25 by 0 00008, which proves the second part of the question

16

Rs 350 87	
23 68	
8 33	
663 94	
1046 82	

Rs 1047

17

361 4	
28 7	95
0 6	3
1 7	64
392 5	89

18

£3 7292	
0 7917	
12 7273	
17 2482	

19

Rs 2 43	
7 149	2
0 421	1
10 000	3

Rs 10

20

Rs 5 486	2
3 625	
888	8
10 000	0

Rs 10

EXAMPLES X c Page 198

1

5 62	
	3 27
15 86	
1 12	4
39	3
18 37	7

2

0 70	28
	4 73
2 81	1
49	1
02	1
3 32	3

3

9 43	57
	5 25
47 17	9
1 88	7
47	2
49 53	8

4

0 03	175
	4 116
0 12	7
00	3
00	0
00	0
0 13	0

5.

5 02	81
	3 17
15 08	4
50	3
35	1
15 93	8

6

702 84	
0	0541
35 14	2
2 81	1
7	0
38 02	3

7

0 78	95
	9 09
7 10	6
07	1
7 17	7

8

3 57	82
	2 376
7 15	6
1 07	3
25	0
02	1
8 50	0

9

0 28	947
	8 643
2 31	5
17	3
01	1
00	1
2 50	0

10

46	20
	8 136
369	6
4	6
1	4
	2
375	8

11.

7	0928
	4 28
28	4
1	4
	6
30	4

12

0	8631
	9 602
7	7
	4
8	1

13

40	0404
	6 06
240	2
2	4
242	6

14

0 561	023
	5 97001
2 805	1
504	9
039	3
3 349	3

15

1 414	21
	1 41421
1 414	2
565	7
014	1
005	6
	3
1 999	9

16

2 400	89
	4 237
9 603	6
480	2
072	0
·016	8
10 172	6

17

1 732	05
	1 73205
1 732	1
1 212	4
052	0
003	5
000	1
3 000	1

18

8 0	6251
	6 317
48 3	7
2 4	2
0	8
0	6
50 9	3

19.

0 0204	76
	2 406
0409	5
0081	9
0001	2
0 0492	6

20

4 1	0208
	7 305
28 7	1
1 2	3
	2
29 9	6

21

59	6159
	3 0807
178	8
4	7
183	5

22

0 786	66
	4 21
3 146	6
157	3
7	9
3 311	8

23

0 573	73
	3 052
1 721	2
28	7
1	1
1 751	0

24

0 526	333
	8 2828
4 210	66
105	27
42	10
1	05
	42
	1
4 359	51

25

0 563	26
	3 277
1 689	8
112	6
39	4
3	9
	4
1 846	1

26

0 760	35
	5 80079
3 801	8
608	2
	5
4 410	5

27

0 314	16
	3 1831
942	5
31	4
25	1
	9
0 999	9

28

79	364
	6 024
476	2
1	5
	3
478	·0 millions

giving answer as 478,000,000.

29 As in Ex 28 we require $4\,085 \times 746$ *to the nearest unit*

746	0
	4 085
2984	
59	7
3	7
3047	4 thousands

giving answer as 3,047,000

30 As in Ex 28 we require $45\,28 \times 6\,402$ *to the nearest unit*

45	28
	6 402
271	7
18	1
	1
289	9 hundred thousands

giving answer as 29,000,000

31 As in Ex 28 we require $80\,460 \times 5\,073$ *to the nearest unit*

80	460
	5 073
402	3
5	6
	2
408	1 millions

giving answer as 408,000,000

32 As in Ex 28 we require $5\,807023 \times 43\,07$ *to the nearest unit*

5	807023
4	3 07
232	3
17	4
	4
250	1 millions

giving answer as 250,000,000

33

39	3701
	7 52
275	6
19	7
	8
296	1

34

2	54
	36
91	44
1	4 75
914	4
365	8
64	0
4	6
1348	8 cm

35

45	25
	5
226	25
	1 6093
226	3
135	7
2	0
	1
364	1 Km

36

2 22	6
	7 031
15 58	2
6	7
	2
15 65	1 Kg

37

224	35
	4 595
897	4
112	2
20	2
1	1
1030	9 hundred thousands

giving answer as £103,100,000

38

29	72897
	4 247
118	9
5	9
1	2
	1
126	1 hundred-thousands

giving answer as £12,600,000

EXAMPLES X d Page 202

1. 8 18 / 1 057)8 6439 / 187 / 81 / 1

2 4 301)75 96 / 32 95 / 2 84 / 26

3 8 212)2 7184 / 2548 / 85

4 2 184)0 06527 / 0 02988 / 2159 / 193 / 19

5 2 9332)28 210 / 9 617 / 1 811 / 51 / 22 / 2

6 2 9364)157 634 / 53 6823 / 10 814 / 2 005 / 243 / 9

7 2 41)1 132 / 0 47 / 168

8 8 425)695 57 / 82 56 / 21 57 / 4 72 / 51

9 4 3507)14 8188 / 3 406 / 1 7667 / 264 / 3

10 2 1979)4 3524 / 1 9802 / 2 15450 / 17639 / 53

11. 5 87)0 1410 / 0 024 / 236 / 2

12 8 04)0 4162 / 0 051 / 142 / 62

13 1 3408)1 7300 / 1 290 / 3892 / 1210 / 4

14 3 3166)11 0000 / 3 316 / 1 0502 / 553 / 221 / 22

15 3 142)1 / 0 318 / 574 / 260 / 9

16 1 7321)3 / 1 732 / 1 2679 / 554 / 34

17 3 1762)8 2626 / 2 601 / 1 9102 / 45 / 14

18 3 081)1 9278 / 0 625 / 792 / 176 / 22

19 $9135)\overline{0\,89700}\;(0\,0981$
7485
177
86

20 $2971)\overline{73\,98}\;(24\,9$
$14\,56$
$2\,68$
1

21 $3080)\overline{0\,04381}\;(0\,0142$
1301
69

22. $203)\overline{18302}\;(901$
32
11

23 $7309)\overline{8276}\;(1132$
967
236
17
2

24 $31897)\overline{35783}\;(1121$
3886
696
59
27

25 $7816)\overline{3464235}\;(443$
3378
252

26 $2164)\overline{905982}\;(418$
403
187
15

27. $80637)\overline{654812}\;(8\,120$
9716
1652
39

28 $114)\overline{1056}\;(92$
28
5

29 $216)\overline{1313854}\;(6082\,6$
1785
574
142
13

30 $12481)\overline{56248}\;(4\,506$
63240
835
86

31 $20\,|\,15\,5s$
$12\,775£$ 192 Rs 15 cents = Rs 192 15

$19215)\overline{12775}\;(0\,06648$
1246
93
16
1

£0·06648 = 15 96d to the nearest hundredth of 1d

32 (i) $5791)\overline{325\,27}\;(561$
3572
97
39

(ii) $2980)\overline{4472}\;(150$
1492
2

(iii) $3176)\overline{4458}\;(140$
1282
12

33 (i) 5·28)6·08266 (1·152
802
274
10

(ii) 6·083)5·2900 (0·868
4136
486

34 (i) 3·93701)0·1000000 (0·025400
212598
15747

(ii) 3·9370)79·200 (20·11
460
62
23

(iii) 3·9370)6·3360 (1·609
2·3990
368
14

35 1·41421)2·00000 (1·4142
58579
2011
597
31

36 3·5128)242·962 (69·165
32 194
579
228
18

Rs 69·165 = Rs 69·17 to the nearest cent
1s 3¾d = £0·0656,
hence 6·917 × 0·656
= 4·5375
giving £4 10s 9d

37 6·2321)1728·00 (277·27
481 58
45 33
1·71

38 1·5025)1000·000 (665·557
98 500
8 350
837
86
11

39 2·2435)3451·7 (1538·5
1208·2
86·5
19·2
1·3

£665·557, giving £665 11s 2d to the nearest penny

40 (i) 4·19768)75·9135 (18·084
33 9367
3573
195
28

(ii) 3·89619)117·2368 (30·090
3511
7

(iii) 5·6367)14·3799 (2·551
3·1065
2861
63
7

EXAMPLES X e Page 205

[To save space the position of the multiplier is sometimes moved

The number of decimal figures to be retained in each case must be decided as in Art 199, Ex 1 and 2]

1

0 23	94
	2 31
47	9
7	2
	2
55	3
	1 57
55	3
27	7
3	9
0 86	9

2

18 60	2
	0 1457
1 86	0
74	4
9	3
1	3
2 71	0
	1 356
2 71	0
81	3
13	6
1	6
3 67	5

3

36 73	0
	0 073
2 57	1
11	0
2 68	1
	0 2367
53	6
8	0
1	6
	1
0 63	3

4

0 97	13
	1 872
97	13
77	70
6	80
	19
1 81	82
	2 423
3 63	64
72	73
3	64
	54
4 40	55

5

21 43	4
	3 721
64 30	2
15 00	4
42	9
2	1

8 532) 79 75 | 6 (9 34

2 96 8
40 8
5 7

6

44 85	2
	1 473
44 85	2
17 94	1
3 14	0
13	4

9 8153) 66 06 | 7 (6 73

7 17 5
30 4
1 0

7

24 36	8
	0 394
7 31	0
2 19	2
09	7

8 97) 9 59 | 9 (1 07

62 9
1

8

0 78	59
	3 0103
2 35	8
	8

4 628) 2 36 | 6 (0 5

5

9

0	42
9	8 0
37	8
3	4
41	2
	5 312
206	0
12	4
	4
	1
218	9

10

65	471
	1 0398
65	47
1	96
	59
	05
68	07
	10 326
680	70
20	42
1	36
	41
702	89

11

3214	00
	1 01359
3214	0
32	1
9	6
1	6
	3

9 47) 3257 | 6 (344
416 6
37 8

12

238	
3	901
714	
214	2
	2

4 83) 928 | 4 (192
445 4
10 7
1 0

13

6 081	75
	5 7002
30 408	8
4 257	2
1	2
34 667	2

2) 69 732 4 (2 011
398
51
16

14.

348
19
502) 6612 (1317
1592
860
358
7

15

1 2327) 2 5721 (2 086
1067
81
9

16 *NB*—In order to obtain a result correct to 4 decimal figures (*i e*, 5 significant figures) we must decimalize £2 1*s* 1½*d* in full This gives £2 05625

4 8632
2 0,5,6,2,5) 10 00000
1 77500
13000
663
46

17

4 8	632
40 0	4
19452 8	
19 4	5

25 21) 19472 2 | 5 (772 40
1825 2
60 5
10 1

18. 2 2046) 10 0000 (4 536
1 1816
793
132

19

1 414	21
1 414	21
1 414	21
565	68
14	14
5	66
	14
	1
1 999	84
1 414	21
1 999	84
799	94
20	00
8	00
	40
	2
2 828	20

20

1 260	01
1 260	01
1 260	01
252	00
75	60
	1
1 587	62
1 260	01
1 587	62
317	52
95	26
	2
2 000	42

21

0 00731	
0 00731	
0 00005	1
	2
0 00005	3
0 00731	
0 00000	0

22 (i)

0 003160	
0 003160	
9	5
	3
	2
0 000009	9 (=a^2)

0 003160	
0 000820	
2	53
	6
0 000002	59 (=ab)

0 000820	
0 000820	
	6
0 000000	6 (=b^2)

(ii)

	0 00065
3 98)	0 002590
	220

23

1	22735
11	1
122	7
12	3
1	2
136	2
	5 1034
681	0
13	6
	4
695	0

24

1249	1
0 00	55
6 24	6
62	5
6 87	1

168	954
23	789
3379	1
506	9
118	2
13	4
1	4
6 87) 4019	0 (585
584	0
34	4

25

3 28	08
	3 2809
9 84	2
65	6
26	2
	2
10 76	2

26.

10 93	6
1	0 936
109 36	
9 81	2
32	8
06	5
119 59	5

27 Using result of Ex 26 and dividing

$$\begin{array}{r} 2\,47 \\ 484\overline{)}\,11\,959 \\ \underline{2\,279} \\ 343 \end{array}$$

28

2 540	
2	54
5 08	
1 270	
101	6
6 451	6
	2 54
12 903	2
3 225	8
258	0
16 387	0

29 60 m an hr = 88 ft per sec, whence multiplier is $\frac{88}{60} = 1\,4667$

30

3 280	8
	2 2046
6 561	6
656	2
13	1
1	9
7 232	8

EXAMPLES X f. Page 211

1
5 42 ± ·005
4 06 ± 005
3 60 ± 005
13 08 ± 015

2
2030 ± 5
1450 ± 5
3380 ± 5
940 ± 5
7800 ± 20

3
6 07 ± 005
8 36 ± 005
7 40 ± 005
21 83 ± 015

4.
16·037 ± 001
0 973 ± 001
2 001 ± 001
19 011 ± 003

5
4 016 ± 0005
0 101 ± 0005
2 892 ± 0005
3 000 ± 0005
10 009 ± 002

6
7 63 ± 005
5 06 ± 005
2 57 ± 01

7
42 3 ± 05
5 26 ± 005
942 ± 0005
48 502 ± 0555

8
4 680 ± 0005
2 073 ± 0005
2 607 ± 001

9
18 009 ± 0005
11 900 ± 0005
6 109 ± 001

10
2 308 ± 0005
3 002 ± 0005
5 310 ± 001
5 304 ± ·0005
0 006 ± 0015

11
7 000 ± 0005
4 420 ± 001
2 580 ± 0015

12 (±0 05 × 10) cm

13 Error for each brick is within ± 05 lb

14 (i) Superior limit $=4\,75\times6\,35$, (ii) Superior limit $=4\,8\times6\,4$,
inferior limit $=4\,65\times6\,25$ inferior limit $=4\,6\times6\,2$

15 (i) Limits are $5\,35\times4\,25$ and $5\,25\times4\,15$
(ii) $6\,05\times5\,05$ and $5\,95\times4\,95$
(iii) 30×22 and 28×20
(iv) 430×500 and 450×520

16
$$\begin{array}{r} 5\,\underline{8} \\ \underline{3\,7} \\ 17\,\underline{4} \\ \underline{4\,0\underline{6}} \\ 21\,\underline{4\,6} \end{array}$$

17
$$\begin{array}{r} 7\,3\underline{2} \\ \underline{6\,0\underline{4}} \\ 43\,9\underline{2} \\ \underline{2\,9\underline{2}\,8} \\ 44\,\underline{2}\,1\underline{2}\,8 \end{array}$$

18
$$\begin{array}{r} 50\,\underline{2} \\ \underline{4\,0\underline{8}} \\ 200\,\underline{8} \\ \underline{4\,0\underline{1}\,6} \\ 204\,\underline{8}\,1\underline{6} \end{array}$$

19
$$\begin{array}{r} 0\,06\underline{17} \\ \underline{3\,3\underline{5}} \\ 1\,8\underline{5}\,1 \\ 1\,8\underline{5}\,1 \\ \underline{3\,0\underline{8}\,5} \\ 2\,0\underline{6}\,6\underline{9}\,\underline{5} \end{array}$$

20
$$\begin{array}{r} 4\,2\underline{6} \\ \underline{0\,5\underline{0}\,8} \\ 2\,1\underline{3}\,0 \\ \underline{3\,4\underline{0}\,8} \\ 2\,1\underline{6}\,4\underline{0}\,8 \end{array}$$

21 Circumference $=431\times(3\,1416\pm\,00005)$ ft
$=(1354\,0296\pm\,02155)$ ft
$=1354\,05115$ ft, or $1354\,00805$ ft
$=1354\,0$ ft correct to nearest tenth

22 Superior limit $=314\,165\times14\,7075$ lbs $=4620\,6$ lbs
Inferior limit $=314\,155\times14\,7065$ lbs $=4620\,1$ lbs

23
$$\begin{array}{r|l} 40\underline{8} & \\ & 0\,5\underline{2}\underline{4} \\ \hline 20\underline{4} & \underline{0} \\ 8 & \underline{2} \\ \underline{1} & \underline{6} \\ \hline 21\underline{3} & \underline{8} \end{array}$$

24 Greatest weight
$=62\,45\times0\,855\times15$ lbs $=800\,92$ lbs
Least weight
$=62\,35\times0\,845\times15$ lbs $=790\,28$ lbs

25 Highest cost $=(\text{Rs } 3500\times\frac{110}{100})\times(80\times\frac{105}{100})$
Lowest cost $=(\text{Rs } 3500\times\frac{90}{100})\times(80\times\frac{97}{100})$

26 Expressing the product in the form $0\,827\times6\,43\underline{5}$, we get

$$\begin{array}{r} 0\,827 \\ \underline{6\,43\underline{5}} \\ 4\,962 \\ 330\underline{8} \\ 248\underline{1} \\ \underline{4\,1\underline{3}\,\underline{5}} \\ 5\,32\underline{1}\,7\underline{4}\,\underline{5} \end{array}$$

This apparently is correct to three significant figures

If, however, we take for the first partial product its strict value, viz

$(0\,827\pm\,0005)\times6=4\,962\pm\,003=4\,965$ or $4\,959$,

we see that the '6' is doubtful This means the '2' in the answer, and, of course, all figures following it are doubtful Thus *two* figures in the answer are correct, which illustrates the principle

27 In first part of question the error in 754 m is 0·5 m.

Since this error is multiplied or divided by the respective multipliers or divisors, we get for answers

(i) 1 Hm, (ii) 1 cm, (iii) 1 Km, (iv) 1 mm

In second part of question, using Art 190,

relative error in (i) $=\frac{0\cdot5\times100}{754\times100}=\frac{0\cdot5}{754}$,

" " (ii) $=\frac{0\cdot5-100}{754-100}=\frac{0\cdot5}{754}$

In the same way the relative errors in (iii) and (iv) may each be shewn equal to $\frac{0\cdot5}{754}$

29
$$\begin{array}{r} 0\,03612 \\ 1728\overline{)\,62\,425} \\ 10\,585 \\ 2170 \\ 4420 \end{array}$$

After the '2' in the quotient the figures are doubtful

From note in Art 205,

Upper limit $=\frac{62\,4255}{1728}=0\,0361259$

Lower limit $=\frac{62\,4245}{1728}=0\,0361253$

These two last results are, of course, the actual limits

The first result is a rough approximation, sufficient to prevent serious error We see that it is correct, however, to four significant figures

For second part of question we have

1 cu. in weighs 0·03612 lb, or (0·03612 × 7000) grs,

or (36·12 × 7) grs, or 252·84 grs

Upper limit gives (36·1259 × 7) grs, or 252·8813 grs

Lower limit gives (36·1253 × 7) grs, or 252·8771 grs

This shews the req^{d} weight is 252·9 grs, which cannot be obtained from the datum It suffices, however, to give a result true to the nearest grain

30
$$\begin{array}{r} 453 \\ 224\overline{)\,101600} \\ 1200 \\ 800 \\ 128 \end{array}$$

31 (i) 1760 × 3 × 12 in = 1609000 mm

$$\begin{array}{r} 25\,4 \\ 6336\overline{)\,160900} \\ 34180 \\ 2500 \end{array}$$

(ii)
$$\begin{array}{r} 1609 \\ 1609 \\ \hline 1609 \\ 9654 \\ 14481 \\ \hline 2588881 \end{array}$$

32 (i) $3\,74)16\,68(4\,46$ (ii) $3\,107)46\,328(14\,91$ (iii) $4\,070)9462\,800(2325$

$1\,720$ $15\,258$ 13228

2240 28300 10180

337 2040

(iv) $3\,72)843700(227000$

997

2530

In every case we see the principle holds good *e g*, in (i) there are 3 figures in divisor At the 3rd division the multiple of the '3' must come vertically under the '8' of the dividend, and here the quotient begins to be uncertain Thus the *two* preceding figures of quotient are certain So for (ii), (iii) and (iv)

33 (i) $3\,1416)7\,2800(2\,32$ (ii) $3\,1416)249000(7920$

99680 290880

54320 81360

34 Superior limit $=\frac{92850}{1855}=500\,5$ secs

Inferior limit $=\frac{92750}{1856}=497\,3$ secs

35 Sp gr $=\frac{1728\times0\,377}{62\,425}=\frac{651\,456}{62\,425}=10\,4.$

EXAMPLES XI a Page 217

1 Ratio $=\frac{\text{Rs } 2^{1}}{\text{Rs } 2^{1}}$ 2 Ratio $=\frac{31\frac{1}{2}d}{70\times12d}$ 3 Ratio $=\frac{255\frac{1}{2}s}{44\frac{3}{4}s}$

4 Ratio $=\frac{13\frac{1}{2}\text{ qrs}}{46\text{ qrs}}$ 5 Ratio $=\frac{\text{Re }\frac{1}{1}}{\text{Rs } 2\frac{2}{1}}$ 6 Ratio $=\frac{17\frac{1}{2}d}{31\frac{1}{4}d}$

7 Ratio $=\frac{31\frac{1}{2}\text{ tons}}{56\frac{1}{4}\text{ tons}}$ 8 Ratio $=\frac{(320+40+1)\text{ p}}{(320+120+35)\text{ p}}$

9 Percentage $=\frac{£19\,25}{£87}\times100$ 13 Percentage $=\frac{£9\,625}{£127\,5}\times100$

14 Percentage $=\frac{£5\,742}{£57\,48}\times100$ 16 Value $=$ Rs $3\,4a\times2\frac{1}{8}$

17 Value $=$ Rs $8\,24\times3\frac{1}{8}$ 18 Value $=$ Rs $2\,219\times5\,84$

19 Rs 2 130 | 4 36

8 520	
639	0
127	8
Rs 9 286	8

20 Rs 384 464 × 0 008351

Rs 384	46
	8 351
3 075	7
115	3
019	2
	4
Rs 3 210	6

21 Value = Rs 565 × 0 04
= Rs 5 65 × 4

23 Value = Rs 4 725 × 4 5
= 2 363 × 9

24 Value = 12 896 × 6 25

25 Value = £0 17133 × 5 5
= £0 85665 × 1 1

26 As No 23

27 Value = £7 24 × 3 375
= £7 24 × $3\frac{3}{8}$

28 Value = £0 81512 × 4 75
= £0 81512 × $4\frac{3}{4}$

29 $\frac{r}{100} = \frac{73\ 41}{1981}$

30 $\frac{x}{100} = \frac{43\ 2}{98\ 473}$

31 $\frac{r}{100} = \frac{224 + 28 + 25}{560}$

32 $\frac{r}{100} = \frac{123\frac{1}{4}\text{ ft}}{151\text{ ft}}$

33 $\frac{v}{100} = \frac{47109}{896431}$

34 As No 33

35 $\frac{r}{1000} = \frac{61\ 14}{361420}$

36 $\frac{r}{100} = \frac{183750}{5250000}$

37 It would save $(62 - 50)\%$ of gross revenue

38 The three partners get $\frac{1}{16}$, $\frac{1}{4}$, $\frac{1}{16}$ respectively of total profits, leaving $\frac{1}{4}$ for the funds Of this last share, the R F gets $\frac{1}{2}$, and the E P F $\frac{1}{2}$

39 For flax, $\frac{r}{100} = \frac{97075 - 55442}{97075}$ For potatoes, $\frac{r}{100} = \frac{982301 - 635321}{982301}$

40 For wheat, $\frac{x}{100} = \frac{321d}{337d}$ For barley, $\frac{r}{100} = \frac{22\frac{2}{7}s}{25\frac{1}{7}s} = \frac{68}{77}$

EXAMPLES XI b Page 221

1 Value = 227 at Rs $(10 - \frac{1}{2})$

2 Value = 309 at Rs $(3 - \frac{1}{12})$

3 Rs 417 5 is value at Re 1 , then 8 a , 2 a , 6 p

4 £160 25 is value at £1 , then 5 s , 1 s 3 d

5 £437 6 is value at £1 , then 10 s , 7 s , 7 d , $3\frac{1}{2}d$

6 Rs 5 0265 is value at Re 1 , then 8 a , 4 a , 4 p

7 Rs 16 308 is value at Re 1 , then 8 a , 4 a , 2 a , 1 a 4 p

8 Rs 1153 5 is value at Re 1 , then 8 a , 2 a

9 Rs 500 76875 is value at Re 1 , then 5 a 4 p

10 Rs 23 775 is value at Re 1, then Rs 2, 8 a, 1 a

11 Area = 2 60125 bigs, Re 1 2 a 8 p = Rs $1\frac{1}{8}$ Then multiply

12 Area = 345 594 ac, £2 2*s* 6*d* = £$2\frac{1}{8}$ Then multiply

13 Weight = 1684 4446 tons, £1 12*s* 6*d* = £$1\frac{5}{8}$ = £$(1+\frac{1}{2}+\frac{1}{8})$ Then multiply

14

	£2 916	666
		13
	37 916	7
2 qrs = $\frac{1}{2}$ cwt	1 458	3
1 qr = $\frac{1}{4}$ cwt	729	2
4 lbs = $\frac{1}{7}$ qr	104	2
	£40 208	4

15

	£2 283	33
		2
	4 566	7
2 qts = $\frac{1}{4}$ gal	1 141	7
1 qt = $\frac{1}{4}$ gal	570	9
1 pt = $\frac{1}{2}$ qt	285	5
	£6 564	8

16

	£3 666	66
2 fur = $\frac{1}{4}$ mi	916	7
40 yds = $\frac{1}{11}$ of $\frac{1}{4}$ mi	083	3
	£1 000	0

17

	£1 712	5
		7
	11 987	5
1 ft = $\frac{1}{3}$ yd	570	8
6 in = $\frac{1}{2}$ ft	285	4
3 in = $\frac{1}{4}$ ft	142	7
	£12 986	4

18

	Rs 42870 833	3
8 a = $\frac{1}{8}$ of Re 1	21435 416	6
5 a 4 p = $\frac{1}{3}$ of Re 1	14290 277	7
	Rs 35725 694	3

19

	Rs 2073 375	
5 a 4 p = $\frac{1}{3}$ of Re 1	691 125	
5 a 4 p = $\frac{1}{3}$ of Re 1	691 125	
1 a = $\frac{1}{16}$ of Re 1	129 585	9
	Rs 1511 835	9

20

	£1710 725	
10*s* = $\frac{1}{2}$ of £1	855 362	5
2*s* 6*d* = $\frac{1}{8}$ of £1	213 840	6
10*d* = $\frac{1}{3}$ of 2*s* 6*d*	71 280	2
$\frac{1}{2}$*d* = $\frac{1}{20}$ of 10*d*	3 564	0
	£1144 047	3

21

£7 714	28
1 370	83
7 714	3
2 314	3
540	0
6	2
	2
£10 575	0

22

£2 070	833
1	99
20 708	3
18 637	5
1 863	8
£41 209	6

23

£1 191	666
30 412	5
35 750	0
476	6
11	9
2	4
	6
£36 241	5

24

Rs 27 48	
5	90
137 40	
24 73	2
Rs 162 13	2

25

Rs 5 029	7
	2 6094
10 059	4
3 017	8
45	2
2	0
Rs 13 124	4

26 Rs 382 828125 × 36 621875

Rs 3828 281	25
	3 6621875
11484 843	8
2296 968	7
229·696	8
7 656	5
382	8
306	2
26	7
1	9
Rs 14019 883	4

27 $7\frac{1}{2}d = \frac{1}{16}$ of 10s

	£
$\frac{1}{4}$	7922 5 = price at 10s
$\frac{1}{4}$	~~1980·625~~
	495 15625
	£7427 34375

28

	Rs
	1232
	11
	13552
2a = $\frac{1}{8}$ of Re 1	154
1a 4p = $\frac{1}{12}$ of Re 1	102 10a 8p
	Rs 13808 10a 8p

29 It loses 8 26666′ in 6 hrs
„ 1 37777′ in 1 hr
Again, 17 days 9 hrs 45 min = 417 75 hrs

1 37	7777 min
41	7 75
551 11	1
13 77	8
9 64	4
96	4
6	9
575 56	6 min

30 $(1\ 7)^3 = 4\ 913$

4 913	
8 788	
39 304	
3 439	1
393	0
39	3
43 175	4

EXAMPLES XII a Page 224

1 They do $(\frac{1}{6}+\frac{1}{12})$, *i e* $\frac{1}{4}$ in 1 day

2 $(\frac{1}{4}-\frac{1}{5})$, or $\frac{1}{20}$ will be filled in 1 min.

3 They do $\left(\frac{1}{5}+\frac{1}{7\frac{1}{2}}\right)$, or $\frac{1}{3}$ in 1 hour

4 They do $(\frac{1}{2}+\frac{1}{3}+\frac{1}{6})$ in 1 day 5 They do $(\frac{1}{9}+\frac{1}{6})$, or $\frac{5}{18}$ in 1 hour

6 $(\frac{1}{25}-\frac{1}{45})$, or $\frac{4}{225}$ is filled in 1 min

7 $(\frac{1}{3}+\frac{1}{4}-\frac{1}{6})$, or $\frac{5}{12}$ is filled in 1 hour

8 $\left(\frac{1}{m}-\frac{1}{n}\right)$, or $\frac{n-m}{mn}$ is filled in 1 min

9 C does $(\frac{1}{10}-\frac{1}{30}-\frac{1}{45})$, or $\frac{2}{45}$ in 1 day

10 They do $(\frac{1}{10}+\frac{1}{12})$, or $\frac{11}{60}$ in 1 day

11 They do $\left(\frac{1}{2a}+\frac{1}{a}+\frac{1}{4a}\right)$, or $\frac{7}{4a}$ in 1 day

12 A and B do $\frac{1}{25}$ in 15 days, A does $\frac{1}{20}$ in 20 days Hence B does $(\frac{1}{25}-\frac{1}{60})$ in 1 day

13 A and B do $\frac{1}{6}$ in 2 days, and A, B, and C do $\frac{1}{4}$ in $6\frac{1}{4}$ days
A and B do $\frac{1}{12}$ in 1 day, and A, B, and C do $\frac{2}{25}$ in 1 day
C (or A) does $(\frac{2}{25}-\frac{1}{12})$ in 1 day, and B does $[\frac{1}{12}-(\frac{2}{25}-\frac{1}{12})]$ in 1 day

14 A and B do $\frac{11}{15}$ in 22 days, or $\frac{1}{30}$ in 1 day A does $\frac{4}{15\times20}$ in 1 day

15 A and B do $\frac{2}{3}$ in 1 day, B and C do $\frac{1}{3}$ in 1 day, C and A do $\frac{1}{12}$ in 1 day,
A does $\frac{1}{2}(\frac{1}{2}+\frac{2}{3}-\frac{1}{3})$ in 1 day, or $\frac{5}{12}$ in 1 day, and earns $\frac{5}{12}$ of 72d,
B „ $\frac{1}{2}(\frac{2}{3}+\frac{1}{3}-\frac{1}{2})$ „ 1 „ $\frac{3}{12}$ „ 1 „ „ $\frac{1}{12}$ of 72d,
C „ $\frac{1}{2}(\frac{1}{2}+\frac{1}{3}-\frac{2}{3})$ „ 1 „ $\frac{1}{12}$ „ 1 „ „ $\frac{1}{12}$ of 72d

16 (i) $(\frac{1}{3}-\frac{1}{4})$ is filled in 1 hour, (ii) $(\frac{1}{4}+\frac{1}{6}-\frac{1}{3})$ is emptied in 1 hour
$\left(\frac{1}{a}-\frac{1}{b}\right)$ is filled in 1 hour, $\left(\frac{1}{b}+\frac{1}{c}-\frac{1}{a}\right)$ is emptied in 1 hour

EXAMPLES XII b Page 227

[*N B* —60 mi per hr $=\frac{60\times1760\times3}{60\times60}$ ft per sec $=88$ ft per sec

1 mi per hr $=\frac{88}{60}$ ft per sec, and 1 ft per sec $=\frac{60}{88}$ mi per hr]

9 528 yds in 6 min, or 5280 yds in 1 hour

10 He rides 22 ft in 1 sec 11 He rides $\frac{88}{60}\times9$ ft in 1 sec

12 $35\times\frac{88}{60}$ ft of train pass in 1 sec 13. $44\times\frac{60}{88}$ miles per hour

14 It travels $45 \times \frac{88}{60}$ ft in 1 sec., hence it travels (150+180) ft in $\frac{330 \times 60}{45 \times 88}$ sec.

15 Let x ft. be length of viaduct then $(x+252)$ ft are traversed in 21 sec But $30 \times \frac{88}{60} \times 21$ ft are traversed in 21 secs hence $x+252 = 30 \times \frac{88}{60} \times 21$

16 Rate of approach = 8 mi per hr and they meet in 4 hrs, 14 mi from A

17 Rate of approach = 10 mi per hr they meet in $2\frac{1}{2}$ hrs, $11\frac{1}{4}$ mi from B's starting place

18 Rate of approach = $1\frac{1}{2}$ mi per hr A overtakes B in 6 hrs

19 Rate of approach = 8 mi per hr hence they meet at 1 45 p m

20 At 9 a.m they are 33 mi apart rate of approach = 11 mi per hr they meet at 12 noon, 12 miles from A

21 Rate of approach = 88 ft. per 1 sec , they pass in $\frac{(185+211)}{88}$ secs

22 Rate of approach = $\frac{88}{60}(25 - 11\frac{1}{2})$ ft per 1 sec,
or $\frac{88}{60} \times 13\frac{1}{2}$ ft per 1 sec.
time req^d = $\frac{(344+196) \times 60}{88 \times 13\frac{1}{2}}$ secs

23 Rate of approach = $7\frac{1}{2}$ mi per hour
(170+150+1000) yds = 1320 yds = $\frac{3}{4}$ mi
time req^d = $\left(\frac{3}{4} \div \frac{1}{7\frac{1}{2}}\right)$ hours

24 Rate of approach = 18 mi per hour, or $18 \times \frac{88}{60} \times 25$ ft per 25 secs
If x ft be length of passenger train, then $x + 1\frac{1}{2}x = 18 \times \frac{88}{60} \times 25$
$x = 264$ ft, and, since 45 mi per hr = 66 ft per sec.,
time req^d = $\frac{264+1650 \times 2}{66}$ secs

EXAMPLES XII c Page 229

1 Average height
= (5 ft 10 in + 5 ft 7½ in + 5 ft 4 in + 4 ft 10½ in + 4 ft 2 in) − 5

2 Average tonnage in 1904 = 126185 − 26
Average tonnage in 1906 = (126185 + 10754 × 2) − 28

3 Av profits for half-year
= [(£416 8s 6d) × 4 + £437 2s + £489 4s] − 6

4 Value req^{d} $=[2s\ 4d \times 12 + 2s\ 6d \times 10 + 2s\ 9d \times 8] - 30$

5 Average from Jan to June
$=(£89\ 5s + £91 + £93\ 15s + £96\ 2s\ 6d + £98 + £99\ 17s\ 6d) - 6$
Average from July to Dec
$=(£99 \times 12 - \text{sum of prices from Jan to June}) - 6$

6 $90\,5 \times 8 - 92 \times 7$

7 Distance $=(88 + 147 + 220 + 352 + 586 + 4840)$ yds in 10 min

8 Average age req^{d} $=\{16\,4 \times 125 + 17\,7 \times 35\} - (125 + 35)$

10 Day's run $=\frac{3514}{5\frac{1}{2}}$ mi , sea speed $=\frac{3514}{5\frac{1}{2} \times 24} \times \frac{60}{69}$ knots

Rest of passage $=1000$ mi, when speed $=\frac{1000}{346} \times \frac{60}{69}$ knots

11 Rainfall for April, May and June, 1907 $=(1\,90 + 0\,94 + 1\,72) = 4\,56$ in
Average for April, 1901–1906 $=(1\,90 - 0\,77) = 1\,13$ in
„ May, „ $=(0\,94 + 1\,46) = 2\,40$ in
„ June, „ $=(1\,72 + 1\,78) = 3\,50$ in
average for April, May and June, 1901–1906 $= 7\,03$ in
rainfall for April, May and June, 1901–1906 $=(7\,03 \times 6)$ in
req^{d} average for the 3 months for 7 years
$=\frac{7\,03 \times 6 + 4\,56}{7 \times 3} = 2\,23$ in

12 6 mi per hr $=\frac{6 \times 1760}{60}$, or 176 yds per min

In the first min the spaces traversed are (i)					yds 0	and (ii)	yds 176×1
„	second	„	„	„	176×1	„	176×2
„	third	„	„	„	176×2	„	176×3
„	fourth	„	„	„	176×3	„	176×4
„	fifth	„	„	„	176×4	„	176×5

total distance (i) $= 1760$ yds, and (ii) $= 2640$ yds
Average of these totals $=\frac{1760 + 2640}{2} = 2200$ yds
From the formula $s = \frac{1}{2} \times 176 \times 5^2 = 2200$ yds

EXAMPLES XII d Page 232

1 (i) The large hand gains 15 min spaces in $\frac{60}{55} \times 15$ min
[Art 219, Ex 1]
(ii) „ „ 45 „ „ $\frac{60}{55} \times 45$ min

2 (i) The large hand gains 45 min spaces in $\frac{60}{55} \times 45$ min
(ii) „ „ $(45 - 30)$ „ „ $\frac{60}{55} \times (45 - 30)$ min

3 The large hand gains $(30-15)$ min spaces in $\frac{60}{55}\times(30-15)$ min
„ „ $(30+15)$ „ „ $\frac{60}{55}\times(30+15)$ „

4 The large hand gains $(25-15)$ min spaces in $\frac{60}{55}\times(25-15)$ min
„ „ $(25+15)$ „ „ $\frac{60}{55}\times(25+15)$ „

5 The large hand gains $(35-12)$ min spaces in $\frac{60}{55}\times(35-12)$ min
„ „ $(35+12)$ „ „ $\frac{60}{55}\times(35+12)$ min

6 In $\frac{60}{55}\times(10-1)$ min and $\frac{60}{55}\times(10+1)$ min after 2 o'clock

7 $\frac{60}{55}\times(25-3)$ min or $\frac{60}{55}\times(25+3)$ min after 5 o'clock

8 A gains 2 yds while B runs 9, A gains 50 yds while B runs 9×25 yds

9 Suppose x lbs at $10\frac{2}{3}$ a are mixed with y lbs at 7 a,
then $\frac{32}{3}x+7y=8(x+y)$

10 Suppose x gls at $14\frac{1}{2}$s are mixed with y gals at $17\frac{1}{2}$s,
then $14\frac{1}{2}x+17\frac{1}{2}y=16\frac{1}{2}(x+y)$

11 Let x srs at 10 a be mixed with $(18-x)$ srs at 11 a,
then $10x+11(18-x)=190$

12 While A walks 440 yds, B walks 420 yds
„ „ C „ 413 yds
B can give C 7 yds in 420,
i e, B „ C $7\times\frac{420}{440}$ „ $420\times\frac{420}{440}$,
or B „ C 2 „ 120

13 Reasoning as in ex 12, we find
B can give C 16 yds in 1728,
i e, B „ C $16\times\frac{1080}{1728}$ „ $1728\times\frac{1080}{1728}$,
or B „ C 10 „ 1080

14. Reasoning as in ex 12, we find
B can give C 5 yds in 90,
i e, B „ C $5\times\frac{150}{900}$ „ $90\times\frac{150}{900}$,
or B „ C $8\frac{1}{3}$ „ 150

15 A scores 100 while B scores 80, (i)
B „ 100 „ C „ 95 (ii)
Multiply by 10 in (i) and by 8 in (ii)
Thus while B scores 800 $\begin{cases} A \text{ scores } 100\times10 \text{ or } 1000, \\ C \text{ „ } 95\times8 \text{ or } 760 \end{cases}$
A can give C 240 in 1000,
or A „ C 24 „ 100

16 A scores 500, while B scores 450, and C scores 432

B can give C 18 in 450,

i.e., B „ C $18\times\frac{100}{450}$ „ $450\times\frac{100}{450}$,

or B „ C 20 „ 500

17 A fires 28 shots to B's 12, and therefore kills 7 while B misses 6

18 A walks 100 yds while B walks 95 yds

B „ $85\frac{1}{2}$ yds while C walks 100 yds

A „ $100\times85\frac{1}{2}$ „ B „ $95\times85\frac{1}{2}$ „ C „ 100×95,

i.e., A walks $85\frac{1}{2}$ yds while C walks 95 yds

C gains $9\frac{1}{2}$ in 95, or 19 in 190, or 1 in 10 on A

thus C gains 176 yds in 1760 yds

19 Rate of approach $=8\frac{1}{4}$ or $\frac{33}{4}$ mi per hr

$=\frac{33\times1760}{4\times60}$, or 242 yds per min

they meet in $\frac{726}{242}$, or 3 min

Since $3\frac{3}{4}$ mi per hr $=\frac{3\frac{3}{4}\times1760}{60}$ or 110 yds per min,

the first man in 3 min walks 110×3 or 330 yds,

and the second man in 3 min walks $(726-330)$ or 396 yds

20 In 1 sec A runs $\frac{100}{10\frac{1}{2}}$ yds, while B runs $\frac{100}{11\frac{1}{6}}$ yds

A runs $\frac{100}{10\frac{1}{2}}\times10\frac{1}{2}$ yds, while B runs $\frac{100}{11\frac{1}{6}}\times10\frac{1}{2}$ yds,

or A „ 100 „ B „ $93\frac{3}{4}$ „

req^{d} start is $6\frac{1}{4}$ yds

21 While B runs 1 yd, A runs $\frac{62}{63}$ yds and C runs $\frac{15}{161}$ yds

A runs $\frac{62}{63}\times\left(\frac{7}{62}\times1760\right)$ yds while C runs $\frac{15}{161}\times\left(\frac{7}{63}\times1760\right)$ yds

or A „ 1760 „ C „ 1680 „

C runs 1680 yds in 5 mins 15 secs or 315 secs

i.e., C „ $1680\times\frac{1760}{1680}$ „ $315\times\frac{1760}{1680}$ secs

or C „ 1760 „ 330 secs or $5\frac{1}{2}$ mins

22 Before they meet A runs 250 yds while B runs 200 yds,

after „ A „ 300 „ B „ $300\times\frac{200}{250}$ yds

i.e., when A reaches the starting pt B has run 240 yds

But when they meet, B was 250 yds from the starting point,

A gets in when B is 10 yds away

23 The leak admits $24\frac{6}{11}$ tons in 1 hr
when the pumps are going, $(24\frac{6}{11}-12)$ tons enter in 1 hr,
i e, " " " $12\frac{6}{11}\times\frac{92}{12\frac{6}{11}}$ " $\frac{92}{12\frac{6}{11}}$ "
she must sail 44 mi in $\frac{92}{12\frac{6}{11}}$ hrs,
i e, " " $44\times\frac{12\frac{6}{11}}{92}$, or 6 miles in 1 hour

24. *A* gained 1 yd in 40 yds, or 11 yds in 440 yds
length of course is 440 yds, run by *A* in 90 secs, and *B* runs 429 yds. in 90 secs

25 First rate of approach = 88 yds in 10 secs = 18 mi per hour
actual speed of train = (18+4) mi, *i e*, 22 mi per hour
Second rate of approach = 88 yds in 9 secs = 20 mi per hour
second man walks at (22−20) mi, *i e*, at 2 mi per hour

26 *A* has walked $3\frac{1}{2}$ mi when met by *B*
A has walked for 63 mins and *B* has walked $5\frac{1}{2}$ mi
in (63+3) min, *i e*, 1 mile in 12 min, or 5 mi per hour

27 The problem is the same as if *B* waited 11 hrs and *A* waited 6 hrs,
or " *B* " 5 " *A* " 0 hrs
That is, just as if *B* started at 9 mi per hr, when *A* had walked 20 miles at 4 mi per hr
Now, rate of approach is 5 mi per hour
B overtakes *A* in 4 hours, *i e*, 9 hours after *A* started, and 36 miles from London

EXAMPLES XII e Page 235

1 Let *A* be x and *B* $(x+3)$ years of age,
then $$\frac{2x}{3}=\frac{5(x+3)}{6}-10$$

2 Let *A*, *B*, *C* be x, $(x+9)$, $(x-6)$ years of age respectively,
then $$\frac{3x}{4}+\frac{4(x+9)}{5}+\frac{x-6}{2}=37,$$
whence $15x+16(x+9)+10(x-6)=740$ and $x=16$

3 Let silk cost $6x$ rupees and linen x rupees per yard,
then $6x\times 23+x\times 50=211\frac{1}{2}$, whence $x=1\frac{1}{8}$

4 Suppose there are x lbs at Re $\frac{7}{8}$ and $(200-x)$ lbs at Rs $\frac{9}{8}$,
then $\frac{7}{8}x+\frac{9}{8}(200-x)=190$, $7x+9(200-x)=1520$ and $x=140$

5 Let rolls be x yds and $(x+25)$ yds in length

$$5\tfrac{1}{2}x+5(x+25)=2015,$$

i e, $11x+10(x+25)=4030$, whence $x=180$

7 Let 1 egg cost x pence then $30-16x=12x-5$

8 Let x be number of oranges then $\frac{15x}{12}-\frac{12x}{15}=162$

$75x-48x=9720$, whence $x=360$

9 Let x be number required then $\frac{6x}{5}=\frac{12x}{11}+6$,

i e, $66x=60x+330$, whence $x=55$

10 Let them meet in x hours then $4(x-2\frac{1}{2})+3x=60$,

i e, $4x-10+3x=60$, whence $x=10$

11 Let x miles be distance required He takes $\frac{2x}{4}$ hours to walk to B and back, at 4 miles an hour Walking to B at $3\frac{1}{2}$ miles an hour, he takes $\frac{x}{3\frac{1}{2}}$ hours, and back to A at $4\frac{1}{2}$ miles an hour, he takes $\frac{x}{4\frac{1}{2}}$ hours The difference in time is $3\frac{1}{3}$ min, i e, $\frac{3\frac{1}{3}}{60}$ hrs,

$$\frac{2x}{4}=\frac{x}{3\frac{1}{2}}+\frac{x}{4\frac{1}{2}}-\frac{3\frac{1}{3}}{60} \quad \text{or} \quad \frac{x}{2}=\frac{2x}{7}+\frac{2x}{9}-\frac{1}{18}$$

$63x=36x+28x-7$, whence $x=7$

12 A gains $1\frac{1}{2}$ miles while walking $4\frac{1}{2}$ miles,

A „ 5 „ „ $5\times\frac{4\frac{1}{2}}{1\frac{1}{2}}$, i e, 15 miles

Time $=\frac{15}{4\frac{1}{2}}$ hrs $=3\frac{1}{3}$ hrs

13 Let distance be x miles at $3\frac{1}{2}$ miles per hour he takes $\frac{x}{3\frac{1}{2}}$ hours, at $3\frac{1}{3}$ miles an hour he takes $\frac{x}{3\frac{1}{3}}$ hours, the latter time is 2 mins, or $\frac{1}{30}$ hour, longer than the former

$$\frac{x}{3\frac{1}{2}}+\frac{1}{30}=\frac{x}{3\frac{1}{3}} \quad \text{i e,} \quad \frac{2x}{7}+\frac{1}{30}=\frac{3x}{10},$$

$60x+7=63x$, whence $x=2\frac{1}{3}$

14 Following the method of Ex 13, we obtain

$$\frac{x}{3\frac{1}{2}}=\frac{x}{3\frac{3}{4}}+\frac{1}{30}, \qquad \frac{2x}{7}=\frac{4x}{15}+\frac{1}{30},$$

$60x=56x+7$, whence $x=1\frac{3}{4}$ miles

15 20 miles diff for the trains = 80 miles distance between the towns,

1 " " = 4 " "

i.e., $14\frac{1}{2}$ " " = $4 \times 14\frac{1}{2}$ " "

giving 58 miles

16 If A rides for x hours before he is overtaken, then B rides for $(x - 1\frac{1}{2})$ hours

$8x = 10(x - 1\frac{1}{2})$, whence $x = 7\frac{1}{2}$, whence distance = 60 miles

For second part of question, if x = req^d number of hrs after noon,

$8x = 10(x - 1\frac{1}{2}) \pm 5$, [see Ex 3, p 235]

whence $x = 10$ or 5, according as B is ahead of or behind A

17 Let x be req^d number of hours after 9 a m ,

then $3\frac{1}{2}x + 2\frac{1}{2}x \pm 5 = 35$ (upper sign gives first time, lower sign gives second time), whence $x = 5$ or $6\frac{2}{3}$

18 If x hours is time required, then $12x + 9x + 18 = 60$

$+18$ must be changed to -18

19 C has $\frac{3}{60}$ of 4 mi, *i e* $\frac{1}{5}$ mi, start of A

Now A in walking 5 mi gains 1 mi on C in 1 hr

A " 1 mi " $\frac{1}{5}$ mi " C " $\frac{1}{5}$ hr

Again A has $\frac{5}{60}$ of 5 mi, *i e* $\frac{1}{12}$ mi, start of B,

and B in walking 6 mi gains 1 mi on A in 1 hr

B " $\frac{1}{12}$ of 6 mi gains $\frac{1}{12}$ mi on A in $\frac{1}{12}$ hr

or B " $3\frac{1}{2}$ mi " $\frac{1}{12}$ mi " A " 35 min

20 Let x miles be distance up stream

My speed up stream is $(4\frac{1}{2} - 1\frac{1}{2})$ mi , *i e*, 3 mi per hour

" down " $(4\frac{1}{2} + 1\frac{1}{2})$ mi , " 6 mi "

my time up stream is $\frac{x}{3}$ hrs and down stream is $\frac{x-2}{6}$ hrs

$\frac{x}{3} + \frac{x-2}{6} = 2\frac{1}{6}$, whence $x = 5$

Alternative Solution

Up stream the rate of rowing is $4\frac{1}{2} - 1\frac{1}{2}$, or 3 miles per hour

Down " " $4\frac{1}{2} + 1\frac{1}{2}$, or 6 " "

If I had returned to the starting point, the last 2 miles would have taken 20 minutes, and the whole time would have been $2\frac{1}{2}$ hours, two thirds of which must have been occupied by the up stream journey, since the rates of rowing up and down are as 1 to 2

Thus the distance up stream $= \frac{2}{3} \times \frac{5}{2} \times 3 = 5$ miles

21 Let him change his speed v hrs after the start
$9v+15(7-v)=75$, whence $v=5$

22 Suppose he mixes v secrs of milk with y secrs of water
Then $4\frac{1}{2}(v+y)=5v$, whence $v=9y$ and $\frac{x}{y}=\frac{9}{1}$

23 Suppose x gallons of water are added
then $(18+14+x)\times 16\frac{1}{2}=18\times 18\frac{1}{2}+14\times 21$,
$(32+x)\times 33=18\times 37+14\times 42$,
whence $x=6$

24 Let A run $50k$ yds in 1 min
then B runs $45k$ yds in 1 min
Suppose A gets level with B in x min
$50kx=45k(x+5)$,
$50x=45(x+5)$, whence $x=45$

25 Suppose he swims at x miles an hour in still water
In 1 hr he swims $(x+1\frac{1}{3})$ mi down stream,
„ 1 hr „ $(x-1\frac{1}{3})$ mi up stream,
$x+1\frac{1}{3}=5(x-1\frac{1}{3})$, whence $x=2$

26 Let time req^{d} be x hours after 10 30 a m
At this time A is $25(x+3\frac{1}{2})$ miles from Bristol,
„ B „ $20(x+2\frac{1}{4})$ „ „
„ C „ $220-30x$ „ „
$(220-30x)-25(x+3\frac{1}{2})=25(x+3\frac{1}{2})-20(x+2\frac{1}{4})$,
i e $220-30x=50(x+3\frac{1}{2})-20(x+2\frac{1}{4})$,
$220-30x=50x+175-20x-45$,
whence $x=1\frac{1}{2}$, giving 12 noon and 125 mi from Bristol

MISCELLANEOUS EXAMPLES III Page 238

1 Wheat per cwt costs $28s\ 5d\times\frac{11}{4}\frac{8}{0}=28s\ 5d\times\frac{7}{20}=6s\ 8d$
Barley „ $24s\ 5d\times\frac{11}{4}\frac{8}{0}=24s\ 5d\times\frac{7}{20}=6s\ 10d$
Oats „ $17s\ 11d\times\frac{11}{3}\frac{8}{1}=17s\ 11d\times\frac{4}{20}=6s\ 5d$

2 Let Rs x be the average subscription,
then the "other two" give Rs $(x+2)$ and Rs $(x+2\frac{1}{2})$ respectively
$11x=2\times 9+x+2+x+2\frac{1}{2}$, whence $x=2\frac{1}{2}$,
the two persons give Rs 4 8a and Rs 5

3 Tax is £1 on 5 lbs

tax is £13,184,767 on $5 \times 13184767 \times \frac{1}{2240}$ tons,

" £13,181,767 " $\frac{13184767}{448}$ tons, *i e*, on 29130 tons

4 3·5 fr per 1 Kg = £$\frac{3\cdot5}{25\cdot34}$ per 2·204 lbs

= $\frac{3\cdot5\times40}{25\cdot34}$ pence per 2·204 lbs = $\frac{3\cdot5\times240}{25\cdot34\times2\cdot204}$ pence per 1 lb

= $\frac{15}{0\cdot99\cdot31}$ pence per 1 lb = 15*d* per 1 lb

5 He worked 44 hours per week Had he worked for 52 weeks at 7 pice per hour, he would have earned (44 × 7 × 52) pice

But he lost 15 days' work, *i e* (8 × 7 × 15) pice

his net earnings were (44 × 7 × 52 − 8 × 7 × 15) pice

his gain on former contract of Rs 3¾ per week

= (44 × 7 × 52 − 8 × 7 × 15) pice − 52 × 240 pice

= 8{11 × 7 × 26 − 7 × 15 − 52 × 30} pice = 8{7(11 × 26 − 15) − 1560} pice

= 8{7 × 271 − 1560} pice = 8 × 337 pice = Rs 12 2a

6 Req^{l} value = $58\,135823 \times \frac{31\,70\,72\,82}{8\,\cdot\,05\,07\,\cdot}$

= $58\,135823 \times \frac{1\,70\,72\,82}{1\,36\,76\,\cdot}$

This fraction lies between 4 and 5 in value Hence, to obtain a final result correct to *two* decimal figures, we multiply correct to *three* decimal figures, and thus secure the division being correct to *two* decimal places

58 134	823	
	5 950917	
290 670	1	
52 322	2	
2 906	8	
52	3	
2	3	
	4	
345 963		

	252 96
1 36766	345 963
	72 431
	1 018
	1 313
	83

7 $4.875 = £1$, *i e* $4\frac{7}{8} = £1$, $\$15 = £\frac{15}{4\frac{7}{8}}$

Now $£\frac{15}{4\frac{7}{8}} = £\frac{40}{13} = £3\,0769 = £3\ 1s\ 6d$

8 Error = £0 000495 × 317 = £0 157 = 3*s* 1¾*d*

9 His average speed $=\frac{25\frac{1}{2}}{2\frac{1}{4}}$ mi in 1 hr $=\frac{25\frac{1}{2}}{2\frac{1}{4}}\times\frac{88}{60}$ ft in 1 sec

$=\frac{748}{45}$ ft in 1 sec $=\frac{140}{9}$ ft in 1 sec $=17$ ft in 1 sec.

On returning his speed was $\frac{5}{6}$ of 25 mi in $2\frac{1}{4}$ hrs,

or 1 mi in $\frac{2\frac{1}{4}}{\frac{5}{6}\times25\frac{1}{2}}\times60$ mins, or 8 mi in $\frac{5\times6\times2\times60}{5\times4\times51}\times28$ mins,

i e 28 mi in $\frac{108\times28}{17}$ mins, *i e* in 178 mins

10 No of gallons per head $=\frac{3\,56\,80\times16}{4\,33\,3}$ (neglecting unnecessary figs)

$=\frac{120\,1}{4\,33}=29\,8=30$, to nearest whole number

Revenue per head $=£\frac{1}{4}\,\frac{1123}{333}$ (neglecting unnecessary figures)

$=£0\,302=6s$

11

1 0036	59
27	33
200 7318	
70 2561	3
3 0109	8
3011	0
274 3000	1

$x^3-10\,9x^2+9\,4x-102$

$=11^3-10\,9\times11^2+9\,4\times11-102$

$=1331-1318\,9+103\,4-102$

$=12\,1\qquad+1\,4$

$=13\,5$

12 18 mi $=18\times1760$ yds $=\frac{18\times1\cdot60\times64}{70}$ metres,

time req^{d} in secs $=\frac{18\times1\cdot60\times64}{70\times\frac{5}{7}}=\frac{9\times17\cdot6\times64}{7}=\frac{101376}{7}$

$=14482\frac{2}{7}$ giving 4 hrs 1 min $22\frac{2}{7}$ secs

13 *B* runs $\frac{264}{300}$ yds, while *C* runs $\frac{250}{300}$ yds, while *A* runs 1 yd

B „ $\frac{264\times300}{300\times250}\times300$ yds, while *C* runs 300 yds

B „ $\frac{880}{3}$, or $293\frac{1}{3}$ yds, „ *C* „ 300 yds

14 34 mi $=34\times1760\times3$ ft no of knocks in 1 hr $=\frac{34\times1\cdot60\times3}{22}$,

whence no of knocks in $\frac{1}{4}$ min $=\frac{34\times1\cdot60\times3}{22\times60\times4}=34$

15 Income this year $=$ Rs $\frac{25\frac{6}{8}\times192}{5}=$ Rs 984,

Income last year $=$ Rs $\frac{32\frac{1}{64}\times192}{7}=$ Rs 879,

Income next year $=$ Rs 1089, and tax $=6534$ p $=$ Rs 34 0a. 6p

16 Total cost $=$ Rs $3\frac{1}{2}\times10\times5+$ Rs $2\frac{1}{20}\times40$

$=$ Rs $675+$ Rs $92\ 8a=$ Rs $767\ 8a$

he saves Rs $392\ 8a$

17

1 423	056
3	2 6231
42 691	68
2 846	11
853	83
28	46
4	27
	14
46 424	49

$$6\,4395\overline{)\,43\,784}\;(6\,799$$
$$5\,147$$
$$640$$
$$61$$

quotient = 6 80 correct to 2 places of decimals

18 Let 1 man do the work in m days and 1 boy in b days

$\frac{5}{m}=\frac{1}{14}$, and $\frac{5}{m}+\frac{2}{b}=\frac{1}{12}$, $\frac{2}{b}=\frac{1}{12}-\frac{5}{m}=\frac{1}{12}-\frac{1}{14}=\frac{1}{84}$,

whence $m=70$, and $b=168$, since a boy does $\frac{1}{168}$,

while a man does $\frac{1}{70}$, his fraction of a man's work $=\frac{1}{168}/\frac{1}{70}=\frac{5}{12}$

19 $(32\times7\frac{35}{60})$ strokes cover $(1760\times3\times12)$ in,

1 stroke covers $\frac{1760\times3\times12}{32\times7\frac{7}{12}}$ in,

1 „ $\frac{8\,8\,0\times3}{6\,1}$ in, *i e* 261 in

20 $\frac{4}{5}$ of Rs 23 4a 9p + 4757 p + Rs 17 6875

= Rs. 10 5a. 8p + Rs 24 12a 5p + Rs 17 11a.

= Rs 52 13a 1p

21 1s per 1 oz is equiv to £1 per 20 oz, or 25 fr per $1\frac{1}{4}$ lb,

or $\frac{25}{1\frac{1}{4}}$ fr per 1 lb, or $\left(\frac{25}{1\frac{1}{4}}\times0\,002204\right)$ fr per gram,

or $\left(\frac{25}{1\frac{1}{4}}\times2\,204\right)$ fr per Kg, or 44 08 fr per Kg

22 The company would pay £4000 in £20000, or £$\frac{1}{5}$ in £1,

the bank would receive £($\frac{1}{5}$ of 5000), *i e*, £1000, and *A* would pay the bank £4000

A would also lose $\frac{4}{5}$ of £4000, claimed by him

he is out of pocket to the extent of (£4000 + $\frac{4}{5}$ of £4000), or £7200

After the case is taken into court, the company can pay £4000 in £18000, or £$\frac{2}{9}$ in £1,

A has to pay the bank £($\frac{7}{9}$ of 5000)

He has already lost £2000, owing to his claim being reduced, and on this he loses $\frac{7}{9}$ of £2000,

he is out of pocket to the extent of
$£(2000+\frac{7}{9}\text{ of }5000+\frac{7}{9}\text{ of }2000)$
i e, $£7444\frac{4}{9}$,
he is $£(7444\frac{4}{9}-7200)$ more out of pocket,
i e, „ $£244\frac{4}{9}$ „ „

23.

High Tide

Boulogne	*London Bridge*	*Cork*
at 10 3 (Fr)	at { 12 33 (Fr) / 12 23 (Eng) }	at { 3 33 (Fr) / 3 23 (Eng) / 2 58 (Irish) }

24 31 1 gms cost £4 18*s* 10*d*,
21 6 gms „ $£4\,94166\times\frac{2\ 1\ 6}{3\ 1\ 1}$

4 941	66	
	2 16	
9 883	3	
494	2	
296	5	
3 11) 10 674	0	(£3 432
1344		
1000		= £3 8*s* 8*d*
67		
5		

25 Let x be the number of years req^{d} In x yrs he will have saved $£(3000+300x)$ After x yrs $(90-x-30)$ yrs remain During that time he spends £300 per annum

$$3000+300x=300(90-x-30),$$

whence $x=25$ He must work till he is 55

26 From Example 2 (iii), p 227, we see

$$\text{time req}^{d}=\frac{\text{sum of lengths in feet}}{\text{velocity of approach in ft per sec.}}$$

$$=\frac{(210+318)\times 3}{(25-17)\times\frac{88}{60}}=\frac{528\times 3\times 60}{8\times 88}=135\text{ secs}$$

27 1 metre sells for 0 3 fr,
0 914 m „ (0 3 × 0 914) fr
i e 1 yd „ $£\frac{0\ 3\times 0\ 914}{25\ 34}$
500 yds „ $£\frac{0\ 3\times 0\ 914\times 500}{25\ 34}$,
or 500 yds „ $£\frac{13\cdot 1}{25\ 34}$, or £5 410, or £5 8*s* 3*d*.
Now 500 yds cost 1000*d*, or £4 3*s* 4*d*,
profit is £1 4*s* 11*d*

28 With no season ticket
on 3 days of the week he pays 1*s* 10*d* × 3, or 5*s* 6*d* ,
on 3 other days he pays 2*s* × 3, or 6*s*
Since he travels for 47 weeks it costs him 11*s* 6*d* × 47, or £27 0*s* 6*d*
With a season ticket it costs him £20 8*s* + 3*s* × 47 ,
" " " £20 8*s* + £7 1*s* ,
" " " £27 9*s* ,
and answer is "No , loses 8*s* 6*d*"

29 Charge = Rs $\left(\frac{5}{100}\text{ of }2000 + \frac{2\frac{1}{2}}{100}\text{ of }15350\right)$
= Rs 100 + Rs 383 75
= Rs 483 12 a

30 No of First class passengers = $\frac{£356926}{2d}$ = 356926 × 120
" Second class " = $\frac{£472793}{1\frac{1}{2}d}$ = 472793 × 240 × $\frac{4}{6}$,
or 472793 × 48 × 4
If Second class were abolished, the receipts would be
(356926 × 120 + 472793 × 48 × 4) × $1\frac{1}{2}d$,
or $£\frac{(356926 \times 120 + 472793 \times 48 \times 4) \times 3}{2 \times 240}$,
or $£\frac{356926 \times 120 \times 3}{2 \times 240} + £\frac{472793 \times 48 \times 4 \times 3}{2 \times 240}$,
or $£\frac{10707 \cdot 8}{4} + £\frac{2836758}{6}$,
or £835046 2*s*
But the receipts originally were £(356926 + 472793), or £829719
£5327 2*s* is gained

31 Total weight of five bars = (2075 ± 5) × 5 gm
= 10377 5 gm , or 10372 5 gm
Also weight of four bars (3008 ± 5) + (2092 ± 5) + (2014 ± 5)
+ (1093 ± 5) = 8209 gm , or 8205 gm ,
whence limits are 2 1725 Kg , or 2 1635 Kg

32 Each year a population of 1000 become 1009 1 ,
i e, " " " 1 " 1·0091
Hence, if *x* be population 3 years hence,
$x = 77793 \times (1\ 0091)^3 = 77793 \times 1\ 0091 \times 1\ 0091 \times 1\ 0091$
$= 78500 \times 1\ 0091 \times 1\ 0091 = 79215 \times 1\ 0091$
= 79925 = 79900 to nearest hundred

33 Suppose I travel x miles by steamer,
then I travel $(132-x)$ miles by train
The total cost is $x\times\frac{1}{20}$ shillings $+(132-x)\times\frac{1}{12}$ shillings

$$\frac{x}{20}+\frac{132-x}{12}=8, \text{ whence } x=90$$

34 During the 50 miles A rows 4 stretches, *i e*, 24 mi in $\frac{24}{5\frac{1}{2}}$ hrs
" 50 " B " 4 " 24 " $\frac{24}{5}$ hrs
A then rows the last 2 mi in $\frac{2}{5\frac{1}{2}}$ hrs
A and B row 50 miles in $\left(\frac{24}{5\frac{1}{2}}+\frac{24}{5}+\frac{2}{5\frac{1}{2}}\right)$ hrs, or $9\frac{20}{55}$ hrs
During the 50 miles C rows 22 mi in 4 hours,
" " D " 20 mi " 4 "
also C " $5\frac{1}{2}$ mi " 1 " ,
and D " $2\frac{1}{2}$ mi " $\frac{1}{2}$ "
C and D row 50 miles in $9\frac{1}{2}$ hours,
C and D win
After D has reached the winning post,
A rows for $(9\frac{20}{55}-9\frac{1}{2})$ hrs or $\frac{3}{110}$ hrs
A rows $\frac{3}{110}\times5\frac{1}{2}$ miles, *i e*, $\frac{3\times11\times1760}{110\times2}$ yds or 264 yds

35 Q and R ride 2 mi in 12 min P walks 2 mi in 30 min ,
R waits 18 min During this 18 min Q walks $(18\times\frac{4}{60})$ mi, or $1\frac{1}{5}$ mi
Let x miles be distance between meeting places
Q takes $\frac{x}{4}$ hours to walk this
P and R take $\frac{x}{10}$ hours to ride this
But R waited 18 min, or $\frac{18}{60}$ hrs, between Q's departure and P's arrival,
$\frac{x}{4}=\frac{x}{10}+\frac{18}{60}$, whence $x=2$, giving 4 mi from start
Time of reaching second meeting place
= time of riding 2 mi + time of walking 2 mi
= 12 min + 30 min = 42 min (from the start)

PART II.

EXAMPLES XIII a Page 245

13
$$\begin{array}{r|l} 24 & 1\,96\,00\,(140 \\ & 96 \\ \hline & \end{array}$$

14
$$\begin{array}{r|l} 609 & 9\,54\,81\,(309 \\ & 5\,48\,1 \\ \hline & \end{array}$$

16
$$\begin{array}{r|l} 1408 & 50\,12\,64\,(708 \\ & 1\,12\,64 \\ \hline & \end{array}$$

17
$$\begin{array}{r|l} 1805 & 81\,90\,25\,(905 \\ & 90\,25 \\ \hline & \end{array}$$

20
$$\begin{array}{r|l} 67 & 13\,70\,48\,04\,(3702 \\ & 4\,70 \\ 7402 & 1\,48\,01 \\ \hline & \end{array}$$

21
$$\begin{array}{r|l} 2003 & 1\,00\,60\,09\,(1003 \\ & 60\,09 \\ \hline & \end{array}$$

24
$$\begin{array}{r|l} 64 & 11\,57\,42\,84\,41\,(34021 \\ & 2\,57 \\ 6802 & 1\,42\,84 \\ 68041 & 68041 \\ \hline & \end{array}$$

26
$$\begin{array}{r|l} 23 & 1\,74\,34\,56\,16\,(132 \\ & 74 \\ 262 & 5\,34 \quad (1) \\ & 10 \quad (2) \\ \hline & \end{array}$$

At stage (1) we have found the first two figures in the answer

This shews that

$171345616=(13000)^2+5345616$

Simly at stage (2) we see that

$174345616=(13200)^2+105616$

27
$$\begin{array}{r|l} & 18\,46\,42\,09\,(4297 \\ & 18\,40\,41 \\ 8587 & 6\,01\,09 \\ & 6\,01\,09 \\ \hline & \end{array}$$

EXAMPLES XIII. b Page 246

12
$$\begin{array}{r|l} 67 & 0\,00\,13\,98\,76\,(0\,0374 \\ & 4\,98 \\ 744 & 29\,76 \\ \hline & \end{array}$$

13
$$\begin{array}{r|l} 608 & 9\,50\,48\,89\,(3\,083 \\ & 50\,48 \\ 6163 & 1\,84\,89 \\ \hline & \end{array}$$

15 0,00,01,59,51,69 (0·01263
22 | 59
246 | 1551
2523 | 7569

17 27,04,41,60,16 (52·004
102 | 204
10401 | 4160 16

18 6,76,20 80,16 (260·01
46 | 276
52004 | 20 80 16

20 5,35,45,96 (2·31
13 | 1 35
461 | 645
18496

Hence req^{d} answer = 0·018496

EXAMPLES XIII c Page 249

11 0,14 40 (0·3794
67 | 640
749 | 7100
359

12. 2,35,60 (15·3492
25 | 135
303 | 1060
3061 | 156100
30689 | 2841100
8199

15 2·90 (1·70293
3102 | 10000
31019 | 319600
13169

21 $\sqrt{3\frac{7}{81}} = \sqrt{\frac{31\,39}{811}} = \sqrt{\frac{9 \times 3181}{811}}$
$= \frac{3 \times 59}{29}$

28 $\sqrt{4\frac{1}{13}} = \sqrt{\frac{55}{13}} = \sqrt{\frac{715}{13^2}} = \frac{1}{13}\sqrt{715}$

29 $\sqrt{1\frac{1}{17}} = \sqrt{\frac{18}{17}} = \sqrt{\frac{306}{17^2}} = \frac{1}{17}\sqrt{306}$

31 $\sqrt{\frac{1}{4}} = \sqrt{25}$

32 $\sqrt{\frac{25}{0\cdot16}} = \frac{\sqrt{250}}{4}$

33 0·0565 (0·237
43 | 165
467 | 3600
4741 | 3311 (69
47

34 0·0360 (0·1897
28 | 260
369 | 3600
3787 | 27900
3791 | 1391 (36
253

35 $\frac{36}{121}=0.3684\,21\,(0606$

1206	84 21
1212	11 85 (98
	94

36 $3\frac{2}{25}=3.06\,89\,65\,(1751$

27	2 06
345	17 89
3501	64 65
3502	29 64 (846
	1 62
	22

EXAMPLES XIII d Page 251

NB $\sqrt{2}=1.4142136$, $\sqrt{3}=1.7320508$,
$\sqrt{5}=2.2360680$, $\sqrt{6}=2.4494897$,
$\sqrt{7}=2.6457513$, $\sqrt{11}=3.3166248$

1 $\frac{2}{\sqrt{3}}=\frac{2}{\sqrt{3}}\times\frac{\sqrt{3}}{\sqrt{3}}=\frac{2\sqrt{3}}{3}$

3 $\frac{2}{\sqrt{8}}=\frac{2}{\sqrt{8}}\times\frac{\sqrt{2}}{\sqrt{2}}=\frac{2\sqrt{2}}{4}=\frac{\sqrt{2}}{2}$

6 $\frac{\sqrt{2}}{\sqrt{3}}=\frac{\sqrt{2\times3}}{\sqrt{3\times3}}=\frac{\sqrt{6}}{3}$

8 $\frac{25}{\sqrt{11}}=\frac{100}{4\sqrt{11}}\times\frac{\sqrt{11}}{\sqrt{11}}=\frac{100\sqrt{11}}{4\times11}=\frac{331.66248}{4\times11}$

9 $\frac{1}{2\sqrt{3}}=\frac{1}{2\sqrt{3}}\times\frac{\sqrt{3}}{\sqrt{3}}=\frac{\sqrt{3}}{6}$

10 $\frac{1}{\sqrt{24}}=\frac{1}{\sqrt{24}}\times\frac{\sqrt{6}}{\sqrt{6}}=\frac{\sqrt{6}}{12}$

11 Fract$^n=\frac{1}{2+\sqrt{3}}\times\frac{2-\sqrt{3}}{2-\sqrt{3}}=\frac{2-\sqrt{3}}{4-3}=2-\sqrt{3}$

12 Fract$^n=\frac{1}{\sqrt{3}-1}\times\frac{\sqrt{3}+1}{\sqrt{3}+1}=\frac{\sqrt{3}+1}{3-1}=\frac{\sqrt{3}+1}{2}$

13 Fract$^n=\frac{4}{\sqrt{5}-1}\times\frac{\sqrt{5}+1}{\sqrt{5}+1}=\frac{4(\sqrt{5}+1)}{5-1}=\sqrt{5}+1$

14 Fract$^n=\frac{\sqrt{3}-1}{\sqrt{3}+1}\times\frac{\sqrt{3}-1}{\sqrt{3}-1}=\frac{3-2\sqrt{3}+1}{3-1}=2-\sqrt{3}$

15 Fract$^n=\frac{24}{7-\sqrt{5}}\times\frac{7+\sqrt{5}}{7+\sqrt{5}}=\frac{24(7+\sqrt{5})}{49-25}=\frac{6(7+\sqrt{5})}{11}$

16 Fract$^n=\frac{\sqrt{5}+3}{\sqrt{5}-2}\times\frac{\sqrt{5}+2}{\sqrt{5}+2}=\frac{5+5\sqrt{5}+6}{5-4}=11+5\sqrt{5}$

17 $33.17.76\,(576 \quad =24^2$

107	8 17
1146	68 76

18 $1.08.24.32.16\,(10404 \quad =102^2$

46	8 24
5201	8 32 16

19 $0\,\overline{00}\,\overline{00}\,\overline{06}\,\overline{76}\,\overline{52}\,\overline{01}$ (0 002601 $=(0\,051)^2$

46	2 76
5201	52 01

20

143	4 68
1462	3960
1464	10360 (70
	112

47	3 32
540	370

7 3270 (2 706

4^{th} root is 2 71

21

81	1 23
825	42 58
8301	1 3300
8302	4999 (60
	18

124	5 51
1284	55 60
1288	4 24

41 51 60 (6 443

EXAMPLES XIII e Page 253

1 Diagonal $=\sqrt{(161^2+240^2)}$ yds $=\sqrt{(25921+57600)}$ yds $=289$ yds

2 Side $=\sqrt{137^2-88^2}$ ft $=\sqrt{(137+88)(137-88)}$ ft $=\sqrt{225\times 49}$ ft
$=(15\times 7)$ ft

3 Side $=\sqrt{192000-156}$ cubits $=438$ cubits

4 Side $=\sqrt{439\text{ ac }33\text{ p}}=\sqrt{21257582\cdot 5}$ yds $=1457\cdot 9$ yds

5 Side $=\sqrt{450\times 577}$ m $=\sqrt{259650}$ m $=509\cdot 5$ m
Diagonal $=\sqrt{259650\times 2}$ m $=\sqrt{519300}$ m $=720\cdot 6$ m

6 (i) We get $x^2=54\times 1944$, or $v^2=(9\times 6)\times(6\times 9\times 36)$,
$x^2=9^2\times 6^2\times 6^2$, and $v=9\times 6\times 6$

(ii) We get $x^2=65\times 1625$, or $v^2=(5\times 13)\times(13\times 125)$,
$x^2=13^2\times 5^4$, and $x=13\times 5^2$

(iii) We get $v^2=16\,92\times 23\,03=\dfrac{1692\times 2303}{100\times 100}=\dfrac{9\times 4\times 47\times 7\times 7\times 47}{100\times 100}$

$=\dfrac{3^2\times 2^2\times 47^2\times 7^2}{100^2}$, $\quad x=\dfrac{3\times 2\times 47\times 7}{100}=19\cdot 74$.

7 2 sq big 5 sq cot $=3600$ sq yds, side $=60$ yds
cost $=(2\text{ a }3\text{ p})\times 60\times 4=(2\text{ a }+3\text{ p})\times 240=\text{Rs }\frac{240}{8}+60\text{ a}$
$=\text{Rs }33\ 12\text{ a}$

8 Area $=160$ ac $=\frac{640}{4}$ ac $=\frac{1}{4}$ sq mi , side $=\frac{1}{2}$ mile ,
whence perimeter $=2$ miles, and time req^{d} $=30$ min

9 Let x ft and $3x$ ft be its breadth and length respectively ,
then $3x \times x = (17 \times 320 - 10)\frac{9}{4} = 12217\,5$,
whence $x^2 = 4072\,5$ and $x = 63\,8$

10 No of acres $= \dfrac{£987}{£175\frac{11}{40}} = \dfrac{90}{16}$,

No of sq yds $= \frac{90 \times 4840}{16} = \frac{90 \times 100 \times 484}{16}$,
side $= \frac{3 \times 10 \times 22}{4}$ yds , whence perimeter $=660$ yds, and cost $=£104\ 10s$

11 No of slabs $= \dfrac{\text{Rs } 20\frac{1}{4}}{\text{Re } \frac{9}{64}} = 144$, area $= 144 \times 18^2$ sq in , and side $=18$ ft

12 10 ac $=100$ sq chains side $=10$ chains
2 sides $+2$ diagonals $=(20+20\sqrt{2})$ chains or $20(1+\sqrt{2})$ chains or $440(1+\sqrt{2})$ yds
Now 3 mi in 1 hr $=88$ yds in 1 min

$$\text{time taken} = \frac{440(1+\sqrt{2})}{88} \text{ mins} = 5(1+1\,414) \text{ mins}$$
$$= 12 \text{ mins nearly}$$

13 Area $= \frac{1}{2} \times 150 \times 88$ sq yds $=6600$ sq yds ,
side of sq $= \sqrt{6600}$ yds. $=81\,24$ yds

14. (i) $A = \pi r^2 = 3\,1416 \times 100$ sq cm $=314\,16$ sq cm
(ii) side of sq $= \sqrt{314\,16}$ cm $=17\,72$ cm

15 (i) Area $= \frac{1}{4}\sqrt{28 \times 6 \times 10 \times 124} = \frac{1}{4}\sqrt{4 \times 7 \times 144 \times 5} = \frac{1}{4} \times 2 \times 12 \times \sqrt{35}$
$= 6\sqrt{35} = 6 \times 5\,916 = 35\,49$ sq in
(ii) Area $= \frac{1}{4}\sqrt{30 \times 10 \times 10 \times 10} = \frac{1}{4}\sqrt{100 \times 3} = \frac{100}{4}\sqrt{3} = \frac{173\,20}{4}$ sq in

16 $r = \sqrt{\frac{100}{3\,1416}} = \sqrt{31\,8309} = 5\,64$ cm

17 We have $8 \times d^2 \times 0\,7854 = 10000$,
$d^2 = \frac{10000}{8 \times 0\,7854} = \frac{625}{0\,3927} = 1591\,5457$ sq cm ,
whence $d = 39\,89$ cm

18 Velocity $= 332\,4 \times \sqrt{1 + 0\,00366 \times 20} = 332\,4 \times \sqrt{1\,0732}$
$= 332\,4 \times 1\,03595 = 343\,9$ m per sec.

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18 Cost $=(6\frac{1}{3}\times 4\frac{2}{3}\times 9)$a $=(19\times 14)$a $=$Rs 16 10a

19 Cost $=\left(\frac{26\frac{2}{3}\times 20\frac{1}{4}}{9}\times 18\right)d=(20\times 27\times 2)d=$£4 10$s$

20 Cost $=(7\,2\times 5\,5\times 0\,75)$Rs $=29$Rs 70 cents

21 Cost $=(8\,5\times 4\,6\times 9)d=351\,9d=$£1 9$s$ 4d

22 Cost $=\frac{40}{7\frac{1}{2}\times 5\frac{1}{3}}$a $=1$a

23 Cost $=\frac{12\times 16}{21\frac{1}{3}\times 20\frac{1}{4}}$a $\times 9=4$a

24 Area $=(20\times 8\,25)$ sq ch $=165$ sq ch $=16\frac{1}{2}$ ac

26 Area $=(3\,125)^2$ sq big $=9\,765625$ sq big
$=9$ sq big 15 sq cot 5 sq chk

27 Area $=(\frac{8}{4})^2$ sq ch $=(21\,75)^2$ sq ch $=473\,0625$ sq ch
$=47\,30625$ ac $=47$ ac 12 gun 4 a

28 Area $=66$ sq big Length $=19\frac{4}{5}$ big
req^{d} breadth $=\frac{66}{19\frac{4}{5}}$ big $=3$ big 6 cot 4 ft

29 Area $=37\,6607$ ac $=376\,607$ sq ch Breadth $=16\,06$ ch
req^{d} length $=\frac{376\,607}{16\,06}$ ch $=23\,45$ ch

30 Area $=(\frac{3\,5}{10})^2$ sq big $=1\frac{9}{10}$ sq big,
cost $=$Rs $10\frac{1}{2}\times 1\frac{9}{10}=$Rs 16 6a 6p

31 (i) Area $=(805\times 74)$ sq m $=\frac{805\times 4}{10000}$ Ha $=5\,957$ Ha
(ii) Area $=5\,957$ Ha. $=(5\,957\times 2\,5)$ ac $=14\,8925$ ac

32 Cost $=$£$12\frac{1}{2}\times\frac{200\times 85}{10000}=$£$\frac{85}{4}=$£$21\frac{1}{4}$
For second part of question we have $2\frac{1}{2}$ ac cost £12 10s

33 Area $=\frac{225}{50}$ big $=16\,5$ big, breadth $=\frac{16\,5}{7\,5}$ big $=2$ big 4 cot

34 Area $=(\frac{5}{6}$ of $26\,16\times 26\,16)$ sq ch
$=570\,288$ sq ch,
cost $=$£2 12s 6d $\times 57\,0288$
$=$£$2\,616666\times 57\,0288$
$=$£149 225

57 028	8
	2 616666
114·057	6
34 217	3
570	3
342	1
34	2
3	4
	3
149 225	2

35 No req$^{d}=\frac{24\frac{1}{2}\times 15\frac{3}{4}}{\frac{3}{4}\times\frac{1}{2}}=1029$

36 Cost $=\frac{9}{20}$a $\times\frac{20^2\times 144}{8\times 4}=810$a

37 Width $=16$ ft 3 in $=195$ in , length $=\dfrac{1638\times7\times5}{195}$ in $=294$ in

38 If width is x in, then, expressing area in sq in, we have
$288\times18\times x=30\times18\times144$, whence $x=15$

39 On trial it will be found that length of tile must be parallel to width of hall If x be no of tiles req^{d},
then $x\times4\frac{1}{2}\times3\frac{3}{4}=(38\text{ ft }1\frac{1}{2}\text{ in})\times12\times(20\text{ ft }2\frac{1}{4}\text{ in})\times12$,
whence $x=\dfrac{157\frac{1}{2}\times242\frac{1}{4}}{3\frac{3}{4}\times4\frac{1}{2}}=122\times57$
cost of tiles per doz $=\dfrac{£193\frac{1}{2}\times12}{122\times57}=£1\frac{1}{2}$

40 9 in width divides 30 ft 9 in exactly 11 times,
and $(61\text{ ft }6\text{ in})-15=51\frac{3}{4}$,
(41×52) turfs are wanted, of which 41 must be divided

41. No req$^{d}=\dfrac{10\frac{1}{2}\times24\times111}{16\times16}=519$ turfs

We have $\dfrac{24\times12}{16}=18$, and $\dfrac{10\frac{1}{2}\times12}{16}=30\frac{1}{4}$,
shewing that 16 in divides a width of 24 ft exactly,
we have $18\times30\frac{1}{4}=18\times30+18\times\frac{1}{4}=540+9$,
shewing 9 must be divided

42 Area $=(34\times28-30\times24)$ sq yds

43 Cost $=1\frac{1}{4}$ a. $\times(25\times18-21\times14)$

44 Area of footpath $=(83\times47-75\times39)$ sq ft $=976$ sq ft
$=976\times144$ sq in
Area of one tile $=36$ sq in , req^{d} no $=\dfrac{976\times144}{36}=3904$

45 Area of each bed $=(26\times27)$ sq ft

46 Cost for footway $=\dfrac{\text{Rs }2\frac{1}{2}\times67\frac{1}{2}\times5\frac{1}{2}}{9}$,
cost for remainder $=\text{Rs }2\frac{1}{4}\times\dfrac{67\frac{1}{2}\times37\frac{1}{2}}{9}$
total cost $=\text{Rs }\dfrac{67\frac{1}{2}}{9}\left(\dfrac{21}{8}\times\dfrac{11}{2}+\dfrac{9}{4}\times\dfrac{149}{4}\right)=\text{Rs }\dfrac{15}{2}\times\dfrac{393}{4}=\text{Rs }736\text{ 14 a}$

47 Cost of carpet $=\dfrac{28\times22\frac{1}{2}\times18}{9}$ a $=1232$ a
Cost of stain $=\left(\dfrac{10\times4\frac{1}{2}\times8}{9}-\dfrac{28\times4\frac{1}{2}}{9}\right)\times\dfrac{1}{4}$ a $=41$ a
total cost $=1273$ a $=$ Rs 79 9 a

48 Area of tiled portion $=(48\times36-36\times24)$ sq ft $=864$ sq ft
$=864\times144$ sq in

Area of one tile $=(9\times8)$ sq in,

req^{d} no of tiles $=\frac{864\times144}{9\times8}=1728$

Area of boarded portion $=(36\times24)$ sq ft $=(36\times24\times144)$ sq in

Area of one board $=(72\times6)$ sq in,

req^{d} no of boards $=\frac{36\times24\times144}{72\times6}=288$

49 Since corridor is 2 yds wide and surrounds the court,
its length $=54$ yds and its breadth $=34$ yds

Since each path is 2 yds wide and is within the court,
it leaves 48 yds for *total length* and 28 yds for *total breadth* of "remainder",

cost of grass $=(3\times48\times28)s=£201\ 12s$

Also cost of paths and corridor, *at 15s per sq yd*,
$=(54\times34-48\times28)\times15s=£(1836-1344)\times\frac{3}{4}=£369$
total cost $=£570\ 12s$

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1 No of yds $=\frac{20\times15}{2\frac{1}{2}\times3}$

2 Length $=\frac{17\times11\frac{1}{2}}{2\frac{1}{4}\times3}$ yds

3 Width $=\frac{29\frac{1}{7}\times\frac{3}{4}\times9}{14\frac{2}{7}}$ ft

4 Cost $=$ Rs $\frac{9}{2}\times\frac{25\times18}{2\frac{1}{4}\times3}$

5 No of strips $=\frac{16}{2\frac{1}{4}}=7\frac{1}{9}$, 8 strips are required

Cost $=£\frac{1}{6}\times\frac{8\times20\frac{1}{4}}{3}$ Also $\frac{8}{9}$ of the last strip will be wasted

6 No of strips $=\frac{12}{2\frac{1}{2}}=4\frac{4}{5}$, 5 strips are required

Cost $=$ Rs $2\frac{1}{2}\times\frac{5\times3}{5}$ Waste $=\frac{1}{5}$ strip $=\frac{1}{5}$ of $(15\times2\frac{1}{2})$ sq ft

7 No of strips $=\frac{12\frac{3}{4}}{2\frac{1}{4}}=5\frac{2}{3}$, *i e* 6, length $=6\times18$ ft $=36$ yds

Cost $=5\frac{1}{2}s\times36=£9\ 18s$ Waste $=\frac{1}{3}$ of $(18\times2\frac{1}{4})$ sq ft

8 (i) Area $=2\times12\frac{3}{4}\times\{16\frac{2}{3}+15\frac{1}{3}\}$ sq ft $=25\frac{1}{2}\times32$ sq ft $=816$ sq ft

(ii) Area $=2\times15\frac{1}{4}\times\{20\frac{1}{4}+16\frac{5}{12}\}$ sq ft $=31\frac{1}{2}\times36\frac{1}{2}$ sq ft

$=1155$ sq ft

9 Cost $=$ Rs $\frac{18}{16}\times\frac{2\times10\times\{12\frac{3}{4}+11\frac{1}{4}\}}{9}=$ Rs $\frac{18\times2\times10\times24}{16\times9}=$ Rs 60

10 Cost of wall $=\frac{2\times14\times(15+12)}{9}\times9$ a $=$ Rs 47 4 a,
cost of ceiling $=\frac{15\times12}{9}\times4\frac{1}{2}$ a $=$ Rs 5 10 a,
} giving Rs 52 14 a

11 (i) Surface $=2(6\times4+6\times3\frac{1}{2}+4\times3\frac{1}{2})$ sq ft

(ii) Surface $=2(3\frac{1}{2}\times2\frac{1}{3}+3\frac{1}{2}\times1\frac{1}{4}+2\frac{1}{3}\times1\frac{1}{4})$ sq ft

$=(\frac{49}{3}+\frac{35}{4}+\frac{35}{6})$ sq ft

12 Cost $=\frac{2\times(9\times4\frac{1}{2}+9\times3+4\frac{1}{2}\times3)}{9}\times2$ a $=2(4\frac{1}{2}+3+\frac{1}{2}\times3)\times2$ a
(cancelling 9)

13 Area of walls $=2(18\frac{3}{4}+11\frac{1}{4})\times13\frac{1}{2}=810$ sq ft,
area of each piece $=12\times3\times\frac{27}{12}=81$ sq ft,
} giving 10 pieces

14 Area of walls $=2(16\frac{5}{12}+13\frac{7}{12})\times11\frac{1}{4}=675$ sq ft
area to be papered $=620$ sq ft and area of piece
$=12\times3\times\frac{21}{12}=63$ sq ft
Hence no of pieces $=\frac{620}{63}+2=9\frac{53}{63}+2$, *i e* 12 pieces are required

15 Area to be papered $=(4\times18\times11-90)=702$ sq ft
Area of each piece $=2\frac{1}{4}\times12\times3=81$ sq ft
No of pieces $=\frac{702}{81}+1=9\frac{2}{3}$, *i e* 10, and cost $=$ £3

16 Cost $=[2\times(16\frac{3}{4}+10\frac{1}{4})\times11-7\times3-2\times4\times5-4\times3\frac{1}{2}]\times\frac{1}{9}\times9d$
$=(594-21-40-14)d=$ £2 3*s* 3*d*

17 Let x ft be the height, then area to be papered
$=2\times30\times x=60x$ sq ft
Area of each piece $=2\frac{1}{2}\times12\times3=90$ sq ft, costing 5*s*,
35*s* buys 630 sq ft, $60x=630$, whence $x=10\frac{1}{2}$

18 No req$^{d}=2(5\frac{1}{4}\times1\frac{5}{6}+3\times1\frac{5}{6})+5\frac{1}{4}\times3=(2\times\frac{11}{6}\times\frac{21}{4}+\frac{21}{4}\times3)$ sq ft

19 Cost $=\frac{2(3\frac{3}{4}\times3\frac{1}{3}+3\frac{3}{4}\times3+3\frac{1}{3}\times3)}{9}\times4$ a $=\frac{2\times(\frac{15}{4}\times\frac{10}{3}+\frac{10}{3}\times3)}{9}\times4$ a

$=\frac{2\times135\times4}{9\times4}$ a $=$ Re 1 14 a

20 No of pieces $=\frac{21\ 85\times10\ 4\times2}{8\times0\ 45}=126\frac{11}{45}$, *i e* 127
Hence cost $=(127\times4\ 35)$ Rs $=552\ 45$ Rs

21 Total area would cost $2\times(19\frac{1}{2}+14\frac{3}{4})\times11\frac{1}{4}\times8d$
$=2\times8\times34\frac{1}{4}\times11\frac{1}{4}d=6165d$
Again £21 6*s* 5*d* $=5117d$,
req^{d} no of sq ft $=\frac{6165}{8}-\frac{5117}{8}=131$

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1 (i) Area $=\frac{8\ 25\times6\times1550}{144}=\frac{42\ 75}{5}$ sq ft $=533$ sq ft
(ii) Cost $=(8\ 25\times6\times1\frac{1}{2})d=74\ 25d=6s\ 2\frac{1}{4}d$
(iii) Cost $=1d\times\frac{533}{9}=4s\ 11\frac{1}{4}d$ (nearly),
6*s* $2\frac{1}{4}d-4s\ 11\frac{1}{4}d$, or 1*s* 3*d*, is saved

2 (i) Breadth $=\frac{235\ 84}{16\ 75}=14\ 08$ m
(ii) Breadth $=39\ 375\times1408=46$ ft 2 in

3 Width $=\frac{9200}{1000}$ m $=\frac{9\ 2\times39\frac{3}{8}}{36}$ yds $=10\ 1$ yds

4 Cost $=$£$2\ 5\times\frac{42\ 35\times3800}{10000}\times2\frac{1}{2}=$£$(16\ 093\times6\ 25)=$£$100\ 58125$

5 Area to be painted $2\times4\ 5(5\ 65+4\ 35)-18=9\times10-18=72$ sq m
Cost $=\frac{72\times1550}{144\times9}\times\frac{9}{2}d=387\ 5d=$£$1\ 12s\ 3\frac{1}{2}d$

6 1 sq in $=1$ sq mi, $2\ 44$ sq in $=(2\ 44\times640)$ ac $=1561\ 6$ ac

7 640 ac $=(1\ 6)^2$ sq cm, 2000 Ha $=2000\times2\frac{1}{2}\times\frac{1\ 6\times1\ 6}{640}=20$ sq cm

8 $17\frac{1}{2}$ ft $=210$ in, $15\frac{3}{4}$ ft $=189$ in Of these H C F $=21$ in
Since the factors of 21 are 1, 3, 7, 21, we see that the areas of the square tiles must be 1^2, 3^2, 7^2, 21^2 sq in respectively
Thus no of ways $=4$, and the different numbers of tiles are
$\frac{210\times189}{1\times1}$, $\frac{210\times189}{3\times3}$, $\frac{210\times189}{7\times7}$, $\frac{210\times189}{21\times21}$

9 $20\frac{1}{2}\times15$ sq ft cost Rs $16\frac{7}{4}$,
$(20\frac{1}{2}+15)\times10\frac{1}{2}\times2$ sq ft cost Rs $\frac{16\frac{7}{4}\times35\frac{1}{2}\times10\frac{1}{2}\times2}{20\frac{1}{2}\times15}=$Rs 41 2a

10 Area $=\{40\times8+(40+8)\times10\times2-2\times7\times4-5\frac{1}{2}\times2\}=1213$ sq ft
and cost $=\frac{1}{2}$a $\times\frac{1213}{9}=$Rs 37 14a 6p

11 Area $=\frac{1}{2}\times25\times3\ 21$ sq ch $=40\ 125$ sq ch

12 Height $=\dfrac{90\,61}{\frac{1}{2}\times 15\,45}$ m $=11\,73$ m

13 Area $=[\frac{1}{2}\times(34\,72+27\,08)\times 20\,5]$ sq m $=633$ sq m

14 $(\frac{1}{2}\times[13\,46+11\,54]\times 6\,2)$ sq ch cost £38 75, or (25×31) sq ch cost £387 5,

10 sq ch cost $\dfrac{£387\,5\times 10}{25\times 31}$, or 1 ac costs £5

15 (i) $A=(3\,6)^2\times 0\,7854=12\,96\times 0\,7854=10\,18$ sq m

(ii) Cost $=\dfrac{(43)^2\times 0\,7854\times 4}{9}$ a $=\dfrac{1849\times 3\,1416}{9}$ a $=$Rs 40 5a 5p

16 Area $=0\,7854\times(54^2-46^2)=0\,7854\times(54+46)\times(54-46)$
$=0\,7854\times 800$ sq ft

17 Area $=0\,7854\times(210^2-190^2)=0\,7854\times(210+190)(210-190)$ sq ft
$=\dfrac{0\,7854\times 8000}{9}$ sq yds

18 Total cost = cost of rectangle + cost of semi-circular verandah
$=\left[\dfrac{24\frac{3}{4}\times 13\frac{1}{2}\times 40}{9}+\dfrac{(13\frac{1}{2})^2\times 0\,7854\times 48}{2\times 9}\right]$a
$=(1485+381\,7044)$a $=$Rs 116 10a 9p

19 Area $=(110\times 55)$ yds $=\frac{110\times 55}{4840}$ ac
Cost $=256d\times\frac{110\times 55}{4840}\times 3\frac{1}{2}=1120d=£4\ 13s\ 4d$

20 Side $=\sqrt{1600\times 2\frac{1}{4}}=\sqrt{400}\times 9=20\times 3=60$ yds
Area of path $=(60^2-54^2)=(60+54)(60-54)=114\times 6$ sq yds
Cost $=$Rs $\frac{114\times 6\times 4}{10}=$Rs 171

21. 100 sq mi $=1$ sq in, 640 × 100 ac $\equiv 1$ sq in,
whence 931000 ac $=\frac{931}{64}$ sq in, or 14 5 sq in

22 Total area $=3\times 2\,3$, i.e. 6 9 sq cm
Unshaded area $=(4\times\frac{3-1}{2}\times\frac{2\,3-1}{2})$, or 2 6 sq cm
and $=(2\,6\times 25)$ sq ft,
shaded area $=4\,3$ sq cm and $=(4\,3\times 25)$ sq ft

23 If sides are x yds and $2x$ yds, then diagonal $=x\times\sqrt{5}$ yds
But $2x^2=4840$ and $x^2=484\times 5$,
$5x^2=484\times 25$, whence $x\sqrt{5}=22\times 5=110$ yds

24 Let breadth $=x$ yds and length $2x$ yds,
then $2x^2=2244\,5$, whence $x=33\,5$
Perimeter $=6x=6\times 33\,5$,
cost $=(6\times 33\,5\times 13\,25)$ Rs $=(201\times 13\,25)$ Rs $=2663\,25$ Rs.

25 Let x be no of ft in the side of total area
Then area of path in sq ft $=x^2-(x-16)^2=4\times 4840\times 9$,
i e $32x-256=4\times 4840\times 9$
Divide by 32 and $x-8=605\times 9$, giving $x=5453$
Whence $x^2=\frac{(5453)^2}{9\times 4840}$ ac $=\frac{29735209}{43560}$ ac $=682\,6$ ac

26 Let side of larger be x yds, $x^2-71^2=5\times 4840$,
whence $x^2=29241$, and $x=171$

27 Incorrect measurement of length $=15$ ft
Correct " " $=\frac{2\frac{3}{4}}{3}\times 15$ ft $=\frac{11}{12}$ of 15 ft
error in length $=\frac{1}{12}$ of 15 ft
Similarly, error in breadth $=\frac{1}{12}$ of $12\frac{1}{2}$ ft
Error in area = incorrect area − correct area
$=(15\times 12\frac{1}{2}-15\times\frac{11}{12}\times 12\frac{1}{2}\times\frac{11}{12})$ sq ft $=15\times 12\frac{1}{2}\{1-(\frac{11}{12})^2\}$ sq ft
$=29\frac{9}{96}$ sq ft $=30$ sq ft (nearly)

28 Total cost = cost of land + cost of road + cost of houses
$=£(53\times 352\times 3\frac{7}{20})+£(\frac{9\times 352}{9}\times\frac{8}{20})+£87700$ (1)
Receipts from sale $=£[352(53-9)\times 5\frac{13}{20}]$ (2)
Subtracting (2) from (1), we have
Net cost $=£[87700+352(\frac{53\times 67+8}{20}-\frac{44\times 113}{20})]$
$=£[87700+352(\frac{3551+8}{20}-\frac{4960}{20})]$
$=£[87700-17\,6\times 1413]=£(87700-24868\,8)$

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6 Let d metres be depth, then $d\times 0\,65=2\,6$, whence $d=4$.

7 If d cm be depth, then $560\times 250\times d=21000\times 1000$

8 Weight $=(\frac{48}{12}\times\frac{45}{12}\times\frac{25}{12}\times 480$ lbs $)=150$ lbs

9 Req^d no $=4^3\times\frac{25}{40}$

10 Area $=\frac{2156}{12\frac{5}{8}}$ sq ft

11 Cost $=1\frac{1}{2}\times x\times 16\times 7a$, where x is depth in feet
Since Rs $21=336a$, $1\frac{1}{2}\times x\times 16\times 7=336$

12 Let x feet be depth, then $9x=4\frac{1}{2}\times 2\frac{1}{4}\times 1\frac{1}{3}$

13 Let A sq yds be the area Expressing the weight in lbs, we have
$$\frac{0\,42\times 9A\times 710}{12}=2240$$

14. Volume of rainfall per big $=1600\times 9\times\frac{28}{12}$ cu ft
This weighs $\frac{1600\times 9\times 28}{12}\times\frac{1000}{16}\times\frac{35}{72\times 40}$ mds, or $\frac{153125}{6}$ mds

15 Volume of ice $=\frac{4840\times 9}{12}$ cu ft
$$\text{total weight}=\frac{4840\times 9\times 2}{2\times 12}\times\frac{57\frac{1}{4}}{2240}\text{ tons}$$
$$=\frac{121\times 7\times 229}{2\times 448}=92\,8\text{ tons}$$

16 No of gallons per ac = volume in cu ft $\times 6\frac{1}{4}$
$=4840\times 9\times\frac{30}{12}\times\frac{25}{4}=\frac{605\times 45\times 25}{1}=27225\times\frac{100}{4}$ galls

17 Weight = vol in cu ft $\times 710$ lbs
$$=224\times 9\times\frac{1}{8\times 12}\times\frac{710}{112}\text{ cwt}=\frac{2130}{16}\text{ cwt}$$

18 $144\times\frac{7}{4}$ cu in $=30$ lb,
$78\times 42\times\frac{7}{2}$ cu in $=\frac{30\times 4}{144\times 3}\times 78\times 42\times\frac{7}{2}$ lbs $=(5\times 7\times 7\times 13)$ lbs

19 No req$^{d}=\dfrac{30\times 3\times 6\times\frac{13\frac{1}{2}}{12}}{\frac{3}{4}\times\frac{4\frac{1}{2}}{12}\times\frac{3}{12}}=120\times 72$

20 Let A sq ft be area, expressing the volume in cu in,
$$5A\times 1728\times\frac{9}{600\times 2}\times\frac{1}{16}=486,\text{ whence } A=12$$

21 Let l ft be length req^{d}, then
$$1\text{ cwt}=\frac{2\frac{3}{4}\times 1\frac{2}{3}\times 1\frac{1}{2}}{11}\text{ cu ft}=\frac{l\times 120}{18\times 144}\text{ cu ft, whence } l=12$$

22 Vol of rainfall $=3800\times 1760\times 1760\times 3\times 3\times\frac{3}{12}$ cu ft
$=\frac{1000}{4}\times 10\times[38\times 176\times 176\times 9]$
$=250\times 10\times\left[\frac{38\times 176}{10}\times 1760\times 3\right]$ cu ft
$=250\times 10\times[2006\,4\times 1760\times 3]$ cu ft
Now exp^{n} in brackets $=2006\,4$ mi $=(66818\times 3)$ mi
$=(670\times 3)$ mi (nearly)

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N B From Art 247 it follows that
Weight = Volume × Specific Gravity.

1 Wt $=(0\,3\times100^2\times7\,14)$ gms $=21\,42$ Kg

2 (i) Wt $=(2\,5)^3\times1\,2$ gms $=15\,625\times1\,2$ gms
(ii) Wt $=36\times(0\,8)^2\times1\,2$ gms $=23\,04\times1\,2$ gms

3 Wt $=\left(4\frac{1}{2}\times3\frac{1}{2}\times2\frac{1}{2}\times\frac{62\frac{1}{2}\times2\,56}{2240}\right)$ tons $=2\,5$ tons

4 Wt $=(12\times\frac{1\,8}{1\,2}\times\frac{1\,6}{1\,2}\times62\frac{1}{2}\times0\,85)$ lbs $=(1500\times0\,85)$ lbs

5 Wt $=\left(4840\times9\times2\frac{1}{3}\times\frac{62\frac{1}{2}\times1\,28}{2240}\right)$ tons $=121\times3\times125\times0\,08$ tons
$=(363\times10)$ tons

6 Wt $=(44\,5\times2\,4\times2\times0\,55)$ Kg $=(106\,8\times1\,1)$ Kg
$=(117\,48\times\frac{11}{5})$ lbs

7 Let depth be x dm, then $25\times1\,6\times x\times13\,5=540$,
whence $x=1=10$ cms

8 $(35\times6\times25000)$ litres pass in 1 hour
$\left(35\times6\times25000\times\frac{2\frac{1}{2}}{60}\right)$ lit pass in $2\frac{1}{2}$ mins,
i e (350×625) litres pass in $2\frac{1}{2}$ mins

9 Let depth be x dm, then $17\,5\times8\times x=\frac{1\,0}{0\,0}\times3500$,
whence $x=5=50$ cms

10 Wt $=[(16\,8\times1\,25)\times(0\,5\times8\,8)]$ Kg $=[(21\times10)\times(1\times4\,4)]$ Kg
$=92\,4$ Kg $=(92\,4\times\frac{11}{5})$ lbs $=203\,28$ lbs

11 Capacity $=(9-1)\times(7-1)\times(6-1)$ cu in [Art 246 (ii)]

12 Volume of material $=(13\times11\times9-12\times10\times8)$ cu in [Art 246 (iii)]

13 Capacity $=13\times9\times7$ cu in
Vol of material $=(14\times10\times8-13\times9\times7)$ cu in

14 Req^d no of gallons $=50\times3\times15\times6\times6\frac{1}{4}$,
hence time $=\dfrac{50\times3\times15\times6\times6\frac{1}{4}}{125}$ mins $=\dfrac{50\times27}{2}$ mins $=11\frac{1}{4}$ hours

15 No of gals in 10 mins $=4\times1\frac{1}{4}\times(4\times1760\times3)\times6\frac{1}{4}\times\frac{1\,0}{0\,0}$
$=4400\times25$

16 Since 1 ac $=\frac{(100)^2}{2\frac{1}{2}}$ sq m, if x dm be depth req^d

$\left[\frac{(100)^2}{2\frac{1}{2}}\times 10\times 10\times x\right]$ cu dm cover 1 ac But 1000000 litres cover it,

$\frac{(100)^2}{2\frac{1}{2}}\times 10\times 10\times x=1000000$, $x=2\cdot5$ dm $=25$ cm

17 Let x be the fraction req^d, then, expressing weight in lbs,

$$x\times 2240=3\frac{8}{11}\times 2\frac{8}{12}\times 2\times 62\frac{1}{2},$$

whence $x=\frac{2}{5}\frac{5}{6}\frac{5}{4}$

Again, internal surface

$=2(bd+ld)+bl$ (where $l=2\frac{2}{3}$ ft, $b=2\frac{2}{3}$ ft, $d=2$ ft)

$=2(2\frac{2}{3}\times 2+3\frac{2}{3}\times 2)+2\frac{2}{3}\times 3\frac{1}{3}=35\frac{1}{9}$ sq ft

External surface = surface enlarged by thickness of wood corresponding to internal surface + surface on which lid should rest

This last $=2\times$ external length $\times$ thickness $+2\times$ internal breadth $\times$ thickness

external surface

$=2(3\times 2\frac{1}{6}+4\times 2\frac{1}{6})+3\times 4+2\times 4\times\frac{1}{6}+2\times 2\frac{2}{3}\times\frac{1}{6}$

$=42\frac{1}{3}+2\frac{2}{9}=44\frac{5}{9}$ sq ft

cost $=(44\frac{5}{9}+35\frac{1}{9})\times 9$ p $=79\frac{6}{9}\times 9$ p

$=(80-\frac{1}{3})\times 9$ p $=80\times 9$ p -3 p $=$ Rs 3 11 a 9 p

18 Capacity $=\left(2\frac{8}{11}\times 2\frac{7\frac{1}{4}}{12}\times 2\right)$ cu ft $=13$ cu ft

No of lbs of water $=13\times 62\frac{1}{2}\times 19=247\times 62\frac{1}{2}=15437\frac{1}{2}$

19 The water will rise as if its volume had been increased by an amount equal to the volume of the rectangular block Hence if h be the height in feet

$2\frac{1}{2}\times 1\frac{1}{3}\times h=1\frac{1}{2}\times 1\times 1\frac{0}{2}$, $h=\frac{3}{8}$ ft $=4\frac{1}{2}$ in

20 Vol of each brick $=\frac{1}{24}$ cu ft Vol of water displaced by each

$=\frac{1}{17}\times\frac{1}{24}=\frac{5}{51}$ cu ft

The height h to which one brick will raise water is given by $5\times 4\times h=\frac{5}{51}$, whence $h=\frac{1}{510}$

Again, height of water at first $=\frac{30}{4\times 5}=1\frac{1}{2}$ ft,

height left to be covered $=2\frac{1}{6}$ ft,

hence if x be req^d no of bricks $\frac{x}{510}=2\frac{1}{6}$, whence $x=1105$

21 Expressing the volume in c c and weight in gms, if s be sp gr, we have $280\times195\times2\times s=851760$, whence $s=7\cdot8$

22 Area represented $=(2\cdot5\times1\cdot5)\times10^2\times3^2$ sq ft $=25\times15\times9$ sq ft

no of blocks used $=\dfrac{25\times15\times9}{\frac{1}{2}\times\frac{1}{4}}=27000$

Hence no of cartloads req^d $=\dfrac{27000\times\frac{1}{2}\times\frac{1}{4}\times\frac{1}{3}\times62\frac{1}{2}\times0\cdot8}{2240\times2\cdot5}$

$=\frac{13500}{1334}=10$ roughly

Cost $=\dfrac{27000\times\frac{1}{2}\times\frac{1}{4}\times\frac{1}{3}\times62\frac{1}{2}\times0\cdot8}{2240}\times112$ pence

$=\frac{5625}{2}d=£11\ 4s\ 5d$

23 The river discharges in a year

$220000\times60\times24\times365$ cu ft out of $\frac{31}{12}\times4082\times640\times4840\times9$ cu ft

i e $\dfrac{220000\times60\times24\times365}{\frac{31}{12}\times4082\times64\times484\times9}$ cu ft out of 100 cu ft

i e $\frac{10000\times30\times365}{31\times4082\times22\times3}$ % or $\frac{109500000}{2783924}$ % or 39 %

24 Let x sq ft be area of reservoir Since $\dfrac{400000\times30}{6\frac{1}{4}}$ cu ft of water are wanted per day,

$20\times x=\frac{400000\times120}{5}\times184$ (July–Dec $=184$ days),

whence $x=800\times120\times184$ sq ft $=17664000$ sq ft $=406$ ac

Let y sq ft be area of catchment Since 10 in of rainfall are sufficient for 6 months, $y\times\frac{10}{12}$ cu ft $=$ vol of reservoir,

$y\times\frac{10}{12}=20\times17664000$, whence $y=423936000$ sq ft or 15 sq mi

25 Annual discharge $=(30000000\times100\times1\frac{1}{4})$ cu m

If x be the req^d no of days, since x days $=x\times24\times60\times60$ mins,

$170\times60\times60\times24\times x=30000000\times100\times1\frac{1}{4}$,

whence $x=\frac{5000000}{19584}=255$

26 $(1400\times4\times1760\times3)$ cu ft of water pass in 1 hr

$(1400\times4\times1760\times3\times6\frac{1}{4})$ gals „ „ 1 hr

$1400\times4\times1760\times3\times\frac{25}{4}\times24\times365$ gals „ „ 1 year,

whence $\frac{1400\times4\times1760\times3\times25\times24\times365\times28}{4\times7000\times2240}$ tons of matter pass in 1 year

This exp^n $=\frac{600\times365\times69}{7}$ tons $=2374586$ tons

27 We have $\frac{1}{1000}$ cu m $= l \times (0\,002)^2 \times 0\,7854$,

$l = \frac{1}{0\,0031416}$ m , and this is the length of 9 Kg of copper,

length of 7 5 Kg $= \frac{7\,5}{9} \times \frac{1}{0\,0031416}$ m $= 265$ m

EXAMPLES XV. a Page 279

16 The points, in the order given, are represented by A, B, C, D, E, F, G, H in Fig 1 *By measurement* the distance of any one of them from the origin is said to be 5 units

Also if P(x, y) stands for any one of the points,

$$OP^2 = x^2 + y^2$$

The value of $x^2 + y^2$ is found by calculation to be 25 in each case Thus OP $= 5$

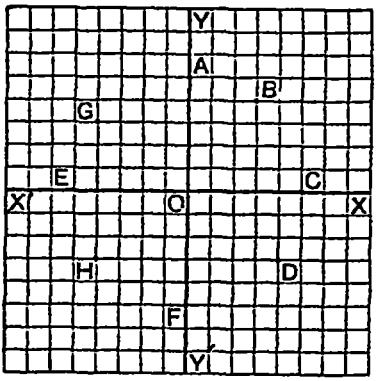

Fig 1

EXAMPLES XV b Page 281

1 The points are shewn in Fig 2, the first series, in the given order, is A, B, C, D, E, and the second series P, Q, R, S, T The coordinates of the intersection of these lines are seen to be 5 and 8, hence the point is (5, 8)

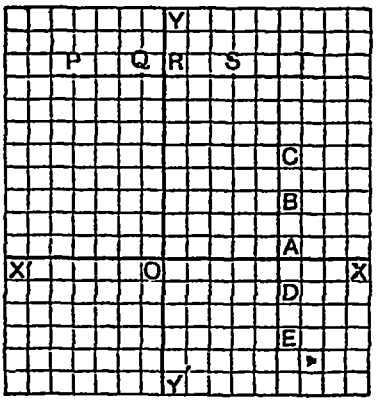

Fig 2

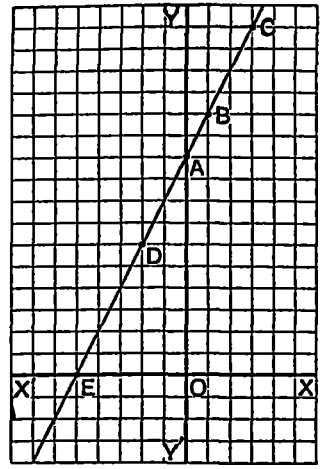

FIG 3

3 Substituting the given values for x in turn in the equation, the corresponding values of y are found to be 10, 12, 16, 6, 0 Hence the points required are (0, 10), (1, 12), (3, 16), (−2, 6), (−5, 0) These are the points A, B, C, D, E plotted in Fig 3, and are seen to lie on a line cutting OX at E and OY at A

5 (i), (ii), (iii) The three lines are parallel, one passing through the origin, and the others making intercepts −4 and 6 on the y axis

6 As in Ex 2, it will be seen that each graph is a line through the origin

7 These points are plotted in the solution of XV a, 16 Since they are equidistant from O, the curve is a circle

EXAMPLES XV c Page 283

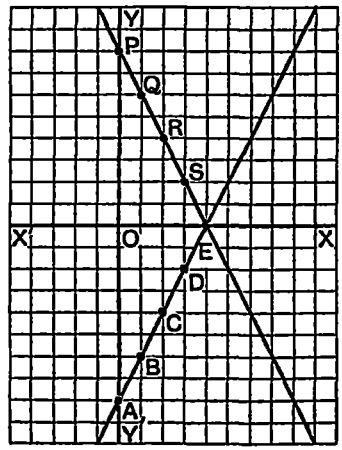

FIG 4

1 Substituting the given values for x in turn in the first equation, the corresponding values of y are found to be −8, −6, −4, −2, 0 Hence the points required are (0, −8), (1, −6), (2, −4), (3, −2), (4, 0)

These are the points A, B, C, D, E plotted in Fig 4 They lie on the line cutting OX at E and OY at A

Similarly for the second equation we obtain the points (0, 8), (1, 6), (2, 4), (3, 2) (4, 0) These are the points P, Q, R, S, E They lie on a line cutting OX at E and OY at P

Thus the required coordinates of the point of intersection are 4, 0

2 Substituting the given values for x, the corresponding values of y in the first equation are 17, 13, 9, 5, 1, -3, in the second equation -9, $-6\frac{1}{2}$, -4, $-1\frac{1}{2}$, 1, $3\frac{1}{2}$ They will be found to lie on two straight lines intersecting at the point (2, 1)

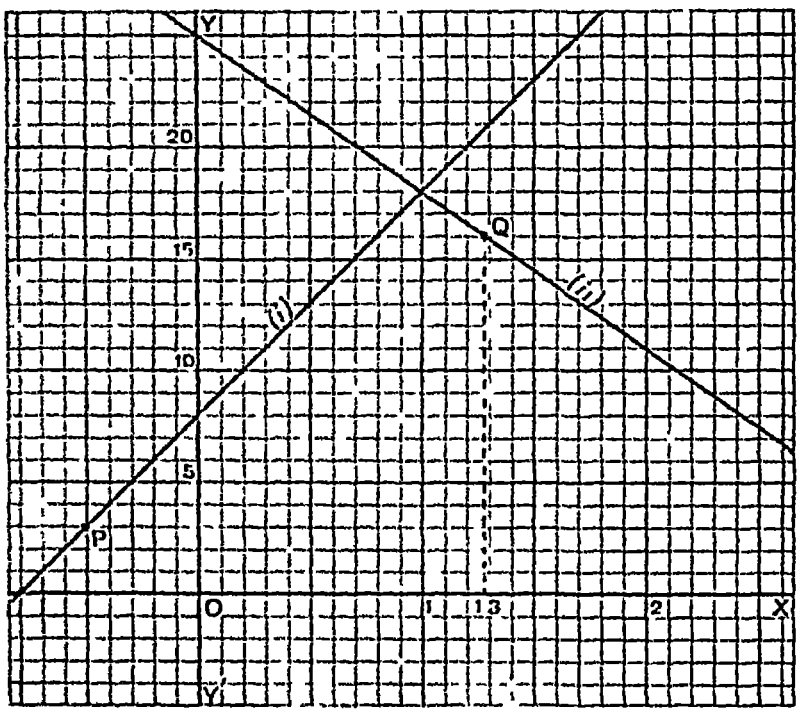

Fig 5

3 The lines are shewn as (i), (ii) in Fig 5

On (i) at P when $x = -\frac{1}{2}$, y is seen to be 3,

(ii) at Q when $y = 10$, x is seen to be 1 3 nearly

4 Substituting the given values for x in turn in the equation, we obtain $y=-4, -3, -2, -1, 0, 1$

Plotting the points, we see they lie on a straight line

When $y=3$, $x=25$, and when $x=-15$, $y=-5$

5 Let us take $\frac{1}{20}$ of an inch as unit for y and one inch as unit for x, then the graph of $y=11x+6$ will be as in Fig 6, in which the line has been drawn by joining the points (0, 6), (2, 28)

Now we see that $x=1\,8$ at the point P, and here $y=26$, nearly

Again $y=20$ at the point Q, and $x=OR=1\,28$, approximately

In obtaining this last result we observe that OR is greater than 1 2 and less than 1 3, and we mentally divide the tenth in which R falls into *ten* equal parts (*i e* into *hundredths of the unit*) and judge as nearly as possible how many of these hundredths are to be added to 1 2

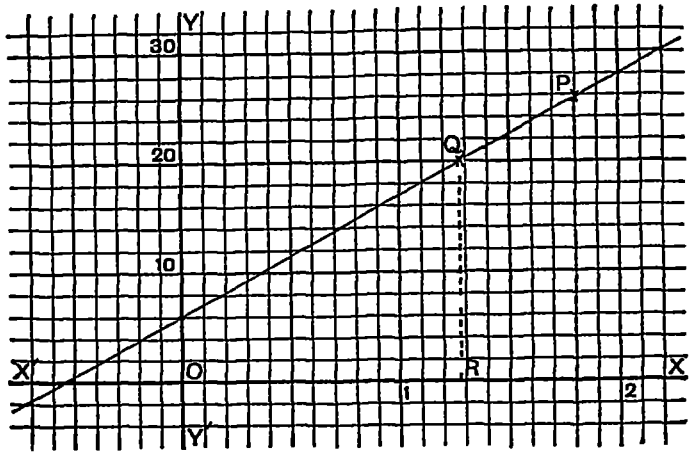

Fig 6

EXAMPLES XV d. Page 289

6 Measure time horizontally and population vertically

Take 0 1 of an inch as unit in each case, also it will be convenient if we begin measuring *abscissæ* at 1830, and ordinates at 20

The graph is given in Fig 7, it will be seen that it passes exactly through the extreme points and lies evenly among the others

The populations in 1848 and 1875, at the points A and B respectively, will be found to be 27 8 millions and 45 3 millions

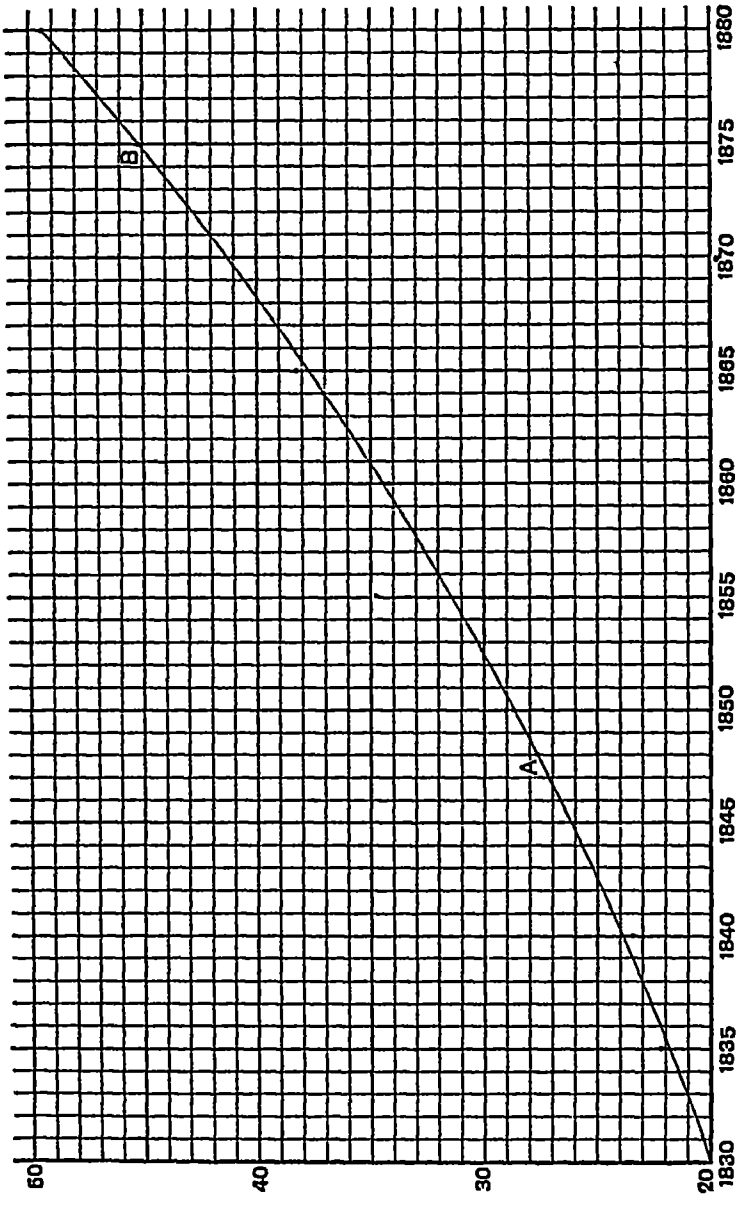
1880
1875
1870
1865
1860
1855
1850
1845
1840
1835
1830
B
A
60
40
30
20

FIG 7

7 A convenient scale is 0·6″ horizontally to each month, and 0·1″ vertically to each degree The curve is shewn on half this scale in Fig 8 It should be remembered that the curve need not necessarily pass through all the points plotted, but only as near to them as possible (Art 259)

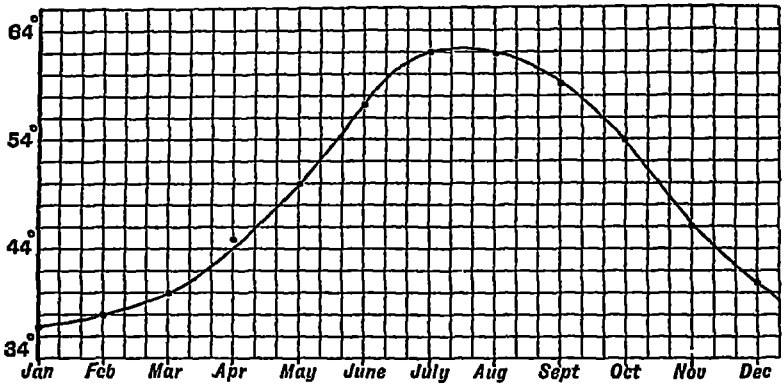

Fig 8

8 Take 0·1″ and 0·4″ to represent the units of circumference and radius respectively The points corresponding to the given values of C and r will be found to lie on a straight line The required values may be read off from the graph

9 The required values are given by the abscissæ of P and Q (Fig 9)

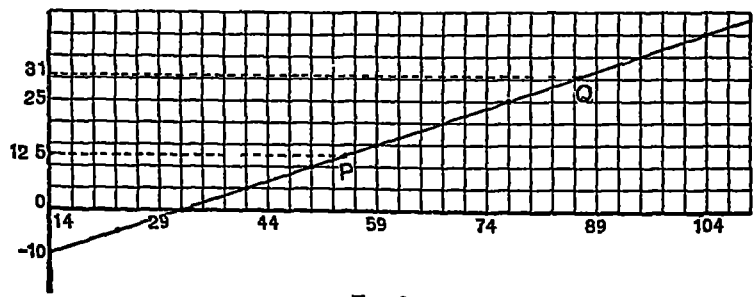

Fig 9

10 The points are plotted in Fig 10, and are seen to lie nearly on a straight line By trial it is found that the line through the 1st and 4th points lies most evenly amongst the remaining points

Assuming the equation to be $y=ax+b$ and, substituting the coordinates of the 1st and 4th points, we find $a=\frac{1}{11}$, $b=\frac{35}{11}$
Hence the equation is $11y=3x+35$
Putting $y=11\,5$ in this, we have $x=30\,5$,
. . $x=10$ . . $y=5\,9$. .

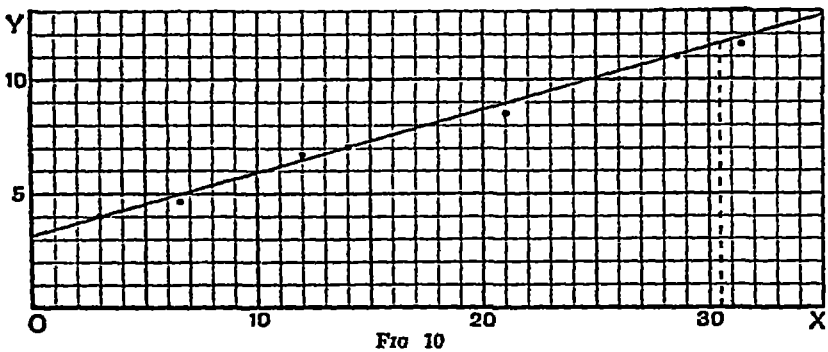

FIG 10

11. Representing the lengths from 8 in to 12 in by ordinates, and the weights from zero to 25 oz. by abscissæ, we find that the graph is a straight line cutting the axis of length at 8 1 Hence when no weight is attached the length is 8 1 in Similarly the weight corresponding to a length of 1 foot is 24 375 oz

12 Representing ages by abscissæ and premiums by ordinates, we find that (on the scale of £2 to an inch) the premiums corresponding to ages 34, 43 are 2 6 and 3 4 Thus the premiums required are £2 12*s* and £3 8*s* (Fig 11)

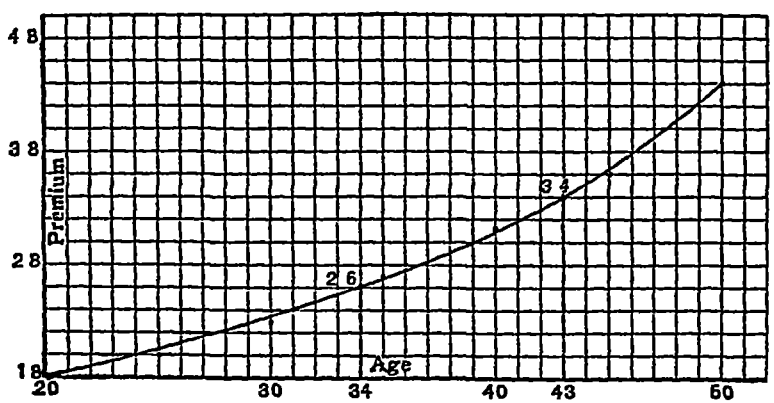

FIG 11

13 The graph is shewn in Fig 12 The abscissæ of P and Q are 17 and 36 5 respectively Hence the required prices are Rs 17 and Rs 36 5

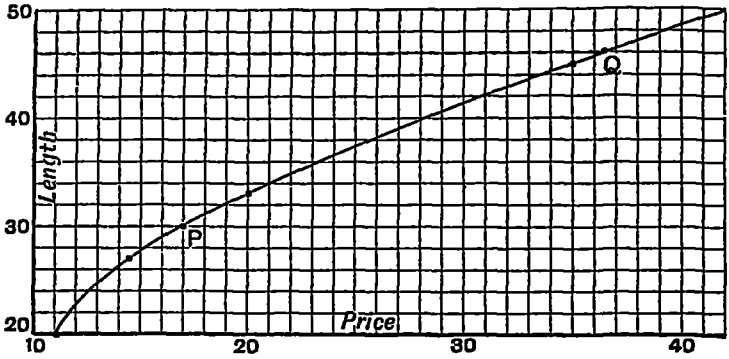

Fig 12

14 The graph is shewn on a small scale in Fig 13 The student should draw his own on double the scales here employed

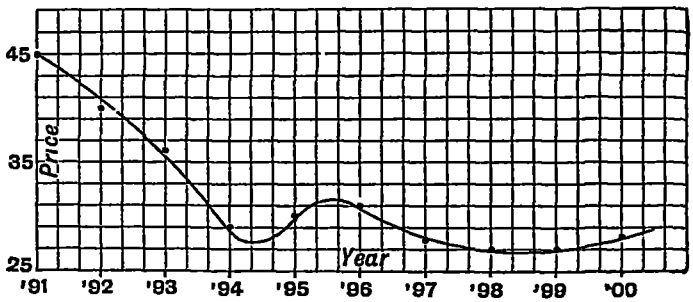

Fig 13

15 Take one-tenth of an inch as unit in each case

Following the method of the Example in Art 260, it will be found that a straight line passes accurately through the 2nd, 5th, and 9th points, and lies evenly among the rest

Assume $y=ax+b$, and, substituting the coordinates of the first and last points, we find $a=0\,5$, $b=-3$

Thus the required equation is $y=0\,5x-3$

From the graph, when $y=15$, $x=36$,

$x=71$, $y=32\,5$

From the equation, when $x=164$, $y=79$

16 See solution of Ex 11

17 Take a scale of 10 years to the inch horizontally and 10000 population to the inch vertically It will also be convenient to take for the origin the point (1830, 20) As in the Example of Art 259, it will be found that the graph of P is a curve passing accurately through the 2nd, 4th, 6th, and 7th points, and lying evenly among the rest

The graph of Q, as in the Example of Art 260, is a straight line passing accurately through the 1st, 3rd, and 7th points, and lying evenly among the others

They intersect at the point (1883, 45), which gives the required year

18 A scale of 0·5″ horizontally to each year of Expectation, and 0·2″ vertically to each year of Age should be employed, the origin being the point (34, 6) It will be found on plotting the points that between the ages 10 and 22 the graph is approximately represented by a straight line Read off the abscissæ of those points on this line whose ordinates are 12 and 20

EXAMPLES XVI a Page 294

9 Since the same rate per ac is charged,

$$\text{ratio}=\frac{£33\ \ 8s\ \ 4d}{£55\ \ 2s\ \ 9d}=\frac{20}{33}$$

10 Let d mi be the total distance and x and y mi per hr their rates, then $49x=d$, and $84y=d$, $\quad 49x=84y$, and $\frac{x}{y}=\frac{84}{49}=\frac{12}{7}$

11 Ratio of speeds $=\frac{\frac{448}{8}}{\frac{504}{12}}=\frac{4}{3}$ 12 Ratio $=\frac{\frac{146}{130}}{\frac{952}{102}}=\frac{9}{20}$

13 The first takes $6\frac{3}{4}$ hrs, the second 6 hrs,

as in No 10, ratio of speeds $=\frac{6}{6\frac{3}{4}}=\frac{8}{9}$

14 The new fraction is $\frac{1r}{18}$ But $\frac{1r}{24}=\frac{r}{8}$

This shews $\frac{1r}{18}>\frac{r}{8}$, since $\frac{1r}{18}>\frac{1r}{24}$

We now see 16 must be added to the consequent

15 Since $8>5$, we should have to add *more* to the numerator than to the denominator in order to get a fraction which $=\frac{8}{5}$ But in this case the quantities added are equal, shewing

$$\frac{8+a}{5+a}<\frac{8}{5}$$

If $\frac{8+a}{5+a}=\frac{7}{5}$, then $5(8+a)=7(5+a)$, whence $a=2\frac{1}{2}$

17 (i) $\frac{548\,1}{62\,43}$, (ii) $\frac{6\,53\times1728\text{ oz}}{62\,43\times16\text{ oz}}$, (iii) $\frac{4\,05\times1728\text{ oz}}{62\,43\times16\text{ oz}}$

18 Let V_1 cu ft be volume of iron, V_2 cu ft volume of steel, weight of $V_1=V_1\times7\,2\times62\,43$ lbs, weight of $V_2=V_2\times8\,0\times62\,43$ lbs

Since these are equal, $V_1\times7\,2\times62\,43=V_2\times8\,0\times62\,43$

$$\frac{V_1}{V_2}=\frac{8\,0}{7\,2}=\frac{10}{9}$$

19 $\text{R F}=\frac{1}{100\times1760\times36}$

1 in $=100$ mi, $1\frac{4}{5}$ in $=180$ mi Simly 830 mi $=8\,3$ in

20 $4\,5$ in $=50$ mi, hence 1 in $=\frac{100}{9}$ mi, *i e* scale is 1 in to $11\frac{1}{9}$ mi,

$$\text{R F}=\frac{1}{\frac{100}{9}\times1760\times36}$$

We find $6\,6$ in $=73\,3$ mi, and $3\,9$ in $=43\,3$ mi

EXAMPLES XVI b Page 298

1-6 See Art 268, Ex 1 and 2 7-9 See Art 268, Ex 4

10 $\frac{ab^2}{a^2b}=\frac{b}{ax}$, whence $x=1$

11-13 See Art 268, "*Three* quantities a, b, c, etc"

14 $\frac{a}{b}=\frac{b}{x}$, $x=\frac{b^2}{a}$ 15-17. See Art 268, "Three quantities, etc"

18 $\frac{a^3b}{x}=\frac{x}{ab^3}$, $x=a^2b^2$

19-25 As in Art 268, Ex 3, put x for missing term

26 Ratio $=\frac{2\,8}{4\,61}=0\,061$

27 $\frac{1 \text{ lb}}{1 \text{ Kg}} = \frac{5}{11}$, $\frac{2240 \text{ lbs}}{1 \text{ Kg}} = \frac{5 \times 2240}{11}$,

hence 1 ton $= \frac{5 \times 2240}{11}$ of 1 Kg $= 1018$ Kg

28 2920 yds $= \frac{200}{219} \times 2920$ m $= \frac{200}{3} \times 40$ m $= 2667$ m

29 $\frac{1 \text{ lit}}{1 \text{ pt}} = \frac{7}{4}$, $\frac{1 \text{ Kl}}{1 \text{ gall}} = \frac{7000}{8 \times 4}$, 1 Kl $= \frac{7000}{32}$ of 1 gall $= 219$ galls

30 From Art 264, Ex 2, we have

$$\frac{\text{sp gr of iron}}{\text{sp gr of copper}} = \frac{\dfrac{\text{wt of 1 cu ft of cast iron}}{\text{wt of 1 cu ft of water}}}{\dfrac{\text{wt of 1 cu ft of copper}}{\text{wt of 1 cu ft of water}}} = \frac{\text{wt of 1 cu ft of cast iron}}{\text{wt of 1 cu ft of copper}}$$

if w lbs be weight required, $\frac{72}{86} = \frac{w}{537 \cdot 3}$,

whence $w = 449 \cdot 8$

EXAMPLES XVI c Page 301

1 (i) Rs $18 \times \frac{11}{9}$, (ii)-(iv), as No (i)

2 Rs $55 \times \frac{84}{10}$ 3 74 mi $\times \frac{54}{1}$ 4 7 m $\times \frac{1583}{119}$

5 26 days $\times \frac{87}{58}$ 6 180 hr $\times \frac{18}{10}$ 7 21 min $\times \frac{20}{58}$

8 Rs $37\frac{1}{2} \times \frac{420}{200}$ 9 110 yds $\times \frac{3}{5\frac{1}{2}}$ 10 $22\frac{1}{2}$ knots $\times \frac{5}{4\frac{1}{2}}$

11 $3\frac{1}{2}$ min $\times \frac{36}{42}$ 12 (i) £56 $\times \frac{21}{20}$, (ii) $7\frac{1}{2}d \times \frac{11}{10}$

13 (i) $57\frac{3}{4}$ mi $\times \frac{16}{21}$, (ii) 192 mins $\times \frac{21}{16}$, (iii) 28 mi $\times \frac{16}{1}$

14 Rs $52 \times \frac{35}{91}$ 15 96 Kg $\times \frac{77}{56}$ 16 27s $\times \frac{1000}{72}$

17 Rs $130\,2 \times \frac{100}{155}$ 18 20 cwt $\times \frac{27}{17\frac{1}{2}}$

19 Time without stoppages $= 270$ min,
average running speed $= 246 \times \frac{60}{270}$ mi
Time with stoppages $= 288$ min,
average speed $= 246 \times \frac{60}{288}$ mi

20 23 62 oz $\times \frac{100}{18}$ 21 214 5 m $\times \frac{84}{132}$ 22 47 12 m $\times \frac{11}{15}$

23 $259 \times \frac{4}{3\frac{1}{2}}$ 24. $220 \times \frac{4\frac{1}{4}}{5\frac{1}{2}}$ 25 $6\frac{1}{2}$ oz $\times \frac{100}{1639}$

26 40 4 mi $\times \frac{5}{8}$ per hr, *i e* 40 4 mi $\times \frac{5}{8} \times \frac{48}{60}$ per 48 min

27 Scale is 126720 in to 1 in, or $\frac{126720}{1760 \times 36}$ mi to 1 in,
i e 2 mi to 1 in, giving 3 8 in and 5 1 mi for other answers

28 $118\frac{1}{2}$ mi to $7\frac{1}{2}$ in $= 15\,8$ mi to 1 in

$$\text{R F} = \frac{1}{15\,8 \times 1760 \times 3 \times 12} = \frac{1}{1001088}$$

$6\,9$ in $= 6\,9 \times 15\,8$ mi $= 109$ mi (nearly)

29 255 6 litres $\times \frac{75}{27} = 710$ litres $= 710$ Kg

30 420 lit $= 420$ Kg $= \frac{11}{5} \times 420$ lbs $= 924$ lbs Time $= 66$ min $\times \frac{112}{100}$

EXAMPLES XVI d Page 304

1 Rs $141\frac{3}{4} \times \frac{52}{28}$ 2 £$1404\frac{1}{10} \times \frac{48}{700}$ 3 £$49\frac{50}{80} \times \frac{56}{28}$

4. 3276 lbs $\times \frac{27}{42}$ 5 39 mi $\times \frac{8\frac{1}{2}}{5}$ 6 65 a $\times \frac{2\frac{1}{4}}{3\frac{1}{4}}$

7 100 min $\times \frac{3\frac{1}{4}}{3\frac{1}{8}}$ 8 $27 \times \frac{32\frac{1}{2}}{22\frac{1}{2}}$ 9 $33 \times \frac{150\,675}{101\,475} = 33 \times \frac{2009}{1353}$

10 45 srs $\times \frac{29}{16\frac{5}{16}}$ 11 75 mi $\times \frac{2\frac{3}{4}}{6\frac{1}{4}}$ 12 £$10\frac{1}{10} \times \frac{3\frac{4}{5}}{36}$

13 1 cwt $\times \frac{21\frac{5}{6}}{1\frac{1}{6}}$ 14 200 lbs $\times \frac{4\frac{1}{2}}{\frac{1}{6}}$ 15 Rs $28\frac{7}{8} \times \frac{46}{33}$

16 Re $1 \times \frac{1800}{2520}$ 17 £$1 \times \frac{348\frac{1}{3}}{1520}$ 18 Rs $125 \times \frac{410}{1000}$

19 £$141\frac{1}{10} \times \frac{13\,44}{17\,92}$ 20 Assets $= \frac{3}{4}$ of Rs 1250, loss $=$ Rs $\frac{150}{4}$

21. (i) Tax $= \frac{6}{100}$ on every Re 1 of gross income,

tax $= \frac{6}{100}$ of gross income

(ii) Net income $=$ gross income $-$ tax $= \frac{186}{200}$ of gross income

(iii) Tax $= \frac{6}{180}$ on every Re 1 of net income,

tax $= \frac{6}{180}$ of net income

22 From No 21, net income = Rs $1563\frac{1}{3} \times \frac{180}{173}$

23 From No 21, net income = Rs $6100 \times \frac{\text{Re } 1 - 3a\ 9p}{\text{Re } 1}$

$= \text{Rs } 6100 \times \frac{172}{180}$

24 From No 21, gross income = Rs $59\frac{1}{3} \times \frac{180}{4}$

25 From No 21, tax = Rs $2150\frac{1}{3} \times \frac{6}{187}$

26 Value = rate $\times \frac{240}{30} = £208\frac{1}{3} \times 12$ 27 Rates = $£5676\frac{2}{3} \times \frac{31\frac{1}{2}}{240}$

28 His net income would have been 187 p per Re 1 of gross income instead of 188 p per Re 1 of gross income

Hence net income required = Rs $5264 \times \frac{187}{188}$

29 Total tax is 1s 9d in the £, gross income = $£584 \times \frac{240}{210}$

30 If total income is £x, then $\frac{9}{240}(x - 120) = 17\frac{1}{10}$, whence $x = 580\frac{2}{3}$

Net income = total income tax

31 Let my unearned income be £x,

then $\frac{9}{240}$ of $1174 + \frac{1}{30}$ of $x = 70\frac{9}{30}$, whence $x = 528\frac{1}{3}$

32 4·7 in $\times \frac{52\frac{3}{4}}{70\frac{1}{3}} = \frac{211}{6}$ in, $70\frac{1}{3}$ mi to 4·7 in = 15 mi to 1 in

$$\text{R F} = \frac{1}{15 \times 1760 \times 36 \times 12} = \frac{1}{950400}$$

33 Rs $2450 \times \frac{106}{75} = \text{Rs } \frac{259800}{75} = \text{Rs } 3524$ nearly

34 $21\frac{6}{60}$ hrs $\times \frac{72}{100} = \frac{68 \times 72}{100} = \frac{4896}{40} = 180$ min

35 Rs $434\frac{5}{8} \times \frac{423}{1000}$ 36 Rs $1500 \times \frac{48\frac{3}{10}}{58\frac{17}{20}} = \text{Rs } \frac{777 \times 1500}{945}$

37 78·6 gms $\times \frac{21}{2}$

38 Net income = $\frac{213}{240}$ of £1253

£$\frac{42}{240}$ are saved out of every £ of net income,

$\frac{198}{240}$ of $\frac{213}{240}$ of £1253 is left Thus = $£\frac{1100121}{1200}$

39 Since first section of 18 740 Km cost £3704, at the same rate the whole railway will cost $\frac{18\,740+6\,500}{18\,740}$ of £3704,

or £$\frac{25\times3704}{18\,74}$ = £$\frac{25\cdot3\times1852}{9\cdot37}$ = £$\frac{46855\cdot6}{9\cdot37}$ = £5000

40 1 yd ≡ $2\frac{3}{4}$ lbs, or $\frac{2\frac{3}{4}}{2\frac{1}{2}}$ Kg, 1 metre = $\frac{11}{4}\times\frac{5}{11}\times\frac{35}{32}$ Kg

41 We have 11344 × 8 pints = 1 ac, or 11344 × 8 × $\frac{4}{7}$ lit = $\frac{2}{5}$ Ha,

1 Ha ≡ $\frac{11344\times8\times4\times5}{7\times2}$ litres

42 1 cu in of gold weighs 0 58 oz × $\frac{90}{5}$,

$\frac{5\times8\cdot7}{90\times0\cdot58}$ cu in weigh 8 7 oz, *i e* 0 78 cu in weigh 8 7 oz

EXAMPLES XVI e Page 314

7 Take one tenth of an inch as the unit in each case Suppose y rupees are equivalent to x shillings Then, as in Ex, Art 277, $\frac{y}{16}=\frac{x}{21}$, or $y=\frac{16}{21}x$ Hence, measuring rupees vertically and shillings horizontally, the required graph is at once obtained by joining the origin to the point whose coordinates are 21 and 16 The abscissa corresponding to ordinate 13 is 17 The ordinate corresponding to abscissa 80 is 61

Thus 13 rupees = 17 shillings and 80 shillings = 61 rupees

8 Take scales of an inch to 1 gallon along the axis of x, and one tenth of an inch to 1 litre along the axis of y As in Ex 7, $y=\frac{20}{4\cdot4}x$, which is the equation of a line through the origin Join the origin to the point (4 4, 20), and the graph is obtained The ordinate corresponding to an abscissa $2\frac{1}{2}$ is seen to be 11 4, the abscissa corresponding to an ordinate 20 9 is seen to be 4 6

Hence $2\frac{1}{2}$ gallons = 11 4 litres,

and 20 9 litres = 4 6 gallons

9 Take scales of an inch to the yard along the axis of x, and an inch to a metre along OY Join the point whose coordinates are (6 01″, 5 50″) to the origin The ordinate corresponding to an abscissa 2 22″ is seen to be 2 03″, and therefore

2 22 yards = 20 3 metres

Hence 22 2 yards = 20 3 metres

10 This is most easily done on a very large scale Take 0 1″ horizontally to each grain, and 1 0″ vertically to each gram Since 18 1 grains=1 17 grams, we have 90 5 grains=5 85 grams, and the graph will be the line joining the origin to the point (9·05″, 5 85″)

The abscissa corresponding to ordinate 3 5 is 54 1

The ordinate corresponding to abscissa 30 9 is 2 0

Hence 3 5 grams=54 1 grains,

and 30 9 grains=2 0 grams,

i e 3 09 grains=0 2 gram

11 Take scales of an inch to 1 minute along the axis of x, and an inch to 1000 yards along the axis of y Plot the points, and it will be found they are not in a straight line Therefore the distances are not proportional to the times

For the second part of the question, join the origin to the point (2, 700) and produce this line Read off the ordinate corresponding to abscissa $6\frac{1}{2}$, and we get for req^{d} distance 2300 yds

12 See solution to XV d 8

14 Draw the graph of $y=\frac{69}{88}x$,
and read off the values of y corresponding to $x=40$, 64, 78

15 Cf XV d 12 Plotting the points as in this example, we find they do not lie on a straight line Hence the premium is not directly proportional to the age

For the second part of the question, join the origin to the point (35, 2 8), and read off the values of y corresponding to $x=25$, 30, 40, 45, on this line

16 Take a scale of an inch to a year along the axis of x, and an inch to 100 *increase*, along the axis of y

Regarding the "beginning of 1905" as the "end of 1904," take the point ('04, 0) as origin The increases for 1905, 1906, etc., are 200, 420, 662, 928, respectively

Plotting the points ('04, 0), ('05, 200), ('06, 420), ('07, 662), ('08, 928), we see they do not lie on a straight line hence the increases are not proportional to the times

17 Take 0 1″ vertically to represent 1 penny and 1″ horizontally to represent 1 hour Let y shillings be the wages for x hours, then the graph is that of the equation $y=\frac{4\cdot6}{8}x$

The required values can easily be read off

18 The relation between the actual marks x and the raised marks y is clearly $\frac{y}{x}=\frac{200}{136}$, which represents a st line through the origin

The graph is shewn in Fig 14, the line being drawn through the origin and (68, 100)

The required marks are given by the ordinates of P and Q, and are 90 and 72 respectively

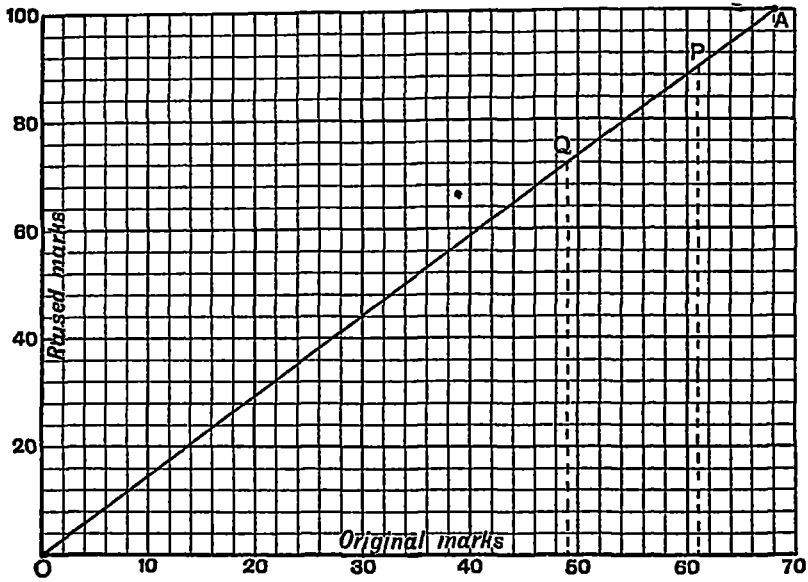

Fig 14.

EXAMPLES XVI f Page 317

1 As in Art 279, Ex 1, req^{d} area=96 sq ft $\times 5\times\frac{2}{3}$

2 As in Art 279, Ex 1 req^{d} weight=$2\frac{1}{2}$ mds $\times 3\frac{1}{2}\times\frac{2}{5}$

3 96 mi $\times\frac{3}{4}\times\frac{1}{8}$

4 Rs $22\frac{1}{2}\times\frac{2}{3}\times\frac{4}{5}$

5 $3\frac{3}{4}$ tons $\times\frac{1}{2}\times\frac{2}{3}\times\frac{3}{5}$

6 225×2240 lbs $\times\frac{1}{2240}\times\frac{1}{7\times 24}$

7 20 wks $\times\frac{10}{1}\frac{50}{00}\times\frac{6}{7}$

8 Rs $1500\times\frac{2}{6}\times\frac{24}{20}$

9 Rs $9\times\frac{6}{4}\times\frac{10}{12}$

10 12 men $\times\frac{18}{30}\times\frac{1}{8}$

11 Rs $736\times\frac{42}{60}\times\frac{30}{35}$

12 9 people $\times\frac{8}{16}\times\frac{6400}{1200}$

13 7 men $\times \frac{9\frac{2}{10}}{9\frac{2}{5}} \times \frac{3}{2}$

14 32 men $\propto \frac{7\frac{1}{10}}{} \propto \frac{20}{8}$

15 65 days $\times \frac{4\frac{2}{3}}{1\frac{1}{6}} \times \frac{8}{6}$

16 24 days $\propto \frac{1\frac{1}{5}}{1\frac{1}{5}} \times \frac{5}{4}$

17 Rs.50 $\times \frac{5\frac{1}{4}}{4\frac{1}{2}} \times \frac{34}{23}$

18 8 wks $\propto \frac{13}{17} \times \frac{257\frac{5}{6}}{121\frac{1}{3}}$

19 £42 75 $\times \frac{4\frac{2}{3}}{1\frac{2}{3}} \times \frac{3}{7} \times \frac{1\frac{1}{2}}{}$

20 120 pages $\propto \frac{2\frac{2}{3}}{4\frac{1}{2}} \times \frac{}{1\frac{1}{6}}$

21 (i) 1 H P $\propto \frac{3 \propto 112 \propto 550}{33000}$, (ii) 1 H P $\propto \frac{5\frac{1}{2} \propto 112 \propto 100 \propto 6}{33000}$,

(iii) 1 H P $\times \frac{440 \propto 10 \times 100 \propto 3}{33000}$

22 1500 men $\times \frac{1\frac{1}{2}}{1\frac{1}{6}} \times \frac{1\frac{1}{2}}{}$

23 35 days $\times \frac{6\,0\,0}{9\,0\,0} \propto \frac{6}{5}$

24 18 5s $\times \frac{2\,4\,5}{3\,7} \propto \frac{2\,6}{9\,8}$

25 40 H.P $\propto \frac{2\,2\,4\,0}{1\,1\,0\,0} \propto \frac{4\,0\,7}{5\,0\,0}$

26 $3\frac{1}{2}$ hrs $\times \frac{2}{3} \times \frac{9}{4}$

27 30 mi. $\propto \frac{7}{5} \propto \frac{1\,2\,6}{1\,0\,5}$

28 40 English navvies are paid 7s $\propto$ 30 $\propto$ 40, i e £420 for the work,
56 Belgian workmen , 5s $\times$ 40 $\propto$ 56, i e £560 „ „
shewing the English navvy is more profitable.
The cost required = £6000 $\propto \frac{5\,2\,0}{4\,1\,0}$

EXAMPLES XVI g Page 321

1.–15 See Art 281

16 Let sides be $5x$, $7x$ and $8x$ yds,
then $5x+7x-12x=270$, whence $x=13\cdot5$

17 Let the marks for the questions be $2\cdot0m$, $3\cdot2m$, $4\cdot8m$,
then $2\cdot0m+3\cdot2m+4\cdot8m=150$, whence $m=15$

18 $1\frac{1}{2}$, 4, $2\frac{1}{2}$ are proportional to 3, 8, 5, lime is $\frac{}{1\,6}$ of $6\frac{2}{3}$ tons
To find percentages, we have $\frac{x}{100}=\frac{3}{16}$, etc.

19 Let $\frac{x}{2}$, $\frac{x}{3}$ and $\frac{x}{9}$ metres be lengths, then $\frac{x}{2}+\frac{x}{3}+\frac{x}{9}=289$ and $x=306$

20. Let $2\frac{1}{2}x$, $3x$ and $3\frac{1}{4}x$ feet be sides,
then $2\frac{1}{2}x+3x+3\frac{1}{4}x=338$, whence $x=40$

21 The shares of the profits are $\frac{4}{20}$ of £165½, $\frac{5}{20}$ of £165½, and $\frac{11}{20}$ of £165½

22 See No 21

23 Contributions are as 3 4 5,
whence percentages are given by $\frac{r}{100}=\frac{3}{12}$, etc

C gets $\frac{r}{12}$ of Rs 15,000

24 They furnish $\frac{425}{1700}, \frac{637}{1700}, \frac{640}{1700}$ respectively of Rs 51,000
For second part of question $\frac{x}{100}=\frac{425}{1700}$

25 The creditors receive $\frac{250}{1000}, \frac{330}{1000}, \frac{420}{1000}$ respectively of £125

26 Shares are $\frac{153}{300}, \frac{117}{300}, \frac{90}{300}$ respectively of 480d

27 Amount req^d $=\frac{22}{25}$ of $300\times123\,274$ grs
$=\frac{11}{25}$ of $100\times123\,274$ grs
$=\frac{11}{25}$ of 12327 4 grs $=33900\ 35$ grs

28 Weight req^d $=\frac{23\ 04}{100}$ of 3750 gm

29 1 cu m $=1000$ litres and weighs 1295 gms
Hence weight of oxygen $=\frac{23\ 04}{100}$ of 1295 gms $=298\ 3$ gms

30 Weight req^d $=\frac{17}{100}$ of 207 4 Kg

31 If shares are £7x, £3x and £2x, then $7x+3x+2x=72\ 6$

32 Suppose C gets Rs x, then B gets Rs $\frac{3x}{2}$ and A gets Rs $\frac{5}{8}\times\frac{3x}{2}$,
$x+\frac{3x}{2}+\frac{15x}{16}=20\frac{5}{8}$, whence $x=6$

33 Since 5 2=35 14, and 7 13=14 26,
A's share B's share C's share=35 14 26
If shares are Rs 35x, Rs 14x and Rs 26x,
then $35x+14x+26x=12\frac{1}{2}$, whence $x=\frac{1}{6}$

34 Since 4s 5s 4d =3 4=21 28,
and 8s 9d 7s 6d =7 6=28 24,
the shares may be taken as £21x, £28x and £24x,
$21x+28x+24x=146$,
and $x=2$

35 $3+20+3=26 \quad 7+56+2=65$

$$\text{Tin}=\left(\tfrac{3}{26}+\tfrac{7}{65}\right)=\tfrac{29}{130} \text{ of total weight}$$

$$\text{Copper}=\left(\tfrac{20}{26}+\tfrac{56}{65}\right)=\tfrac{212}{130} \quad ,$$

$$\text{Zinc}=\left(\tfrac{3}{26}+\tfrac{2}{65}\right)=\tfrac{19}{130} \quad ,, \quad ,,$$

36 The shares are $\frac{20}{45}\ \frac{18}{45}\ \frac{7}{45}$ respectively of £384.

37 See No 36 It should be divided in proportion of

$$50\times6 \quad 85\times4, \text{ or } 15 \quad 17$$

38 See No 36 They should be divided in proportion of

$$60\times3 \quad 40\times5 \quad 125\times2, \text{ or } 18 \quad 20 \quad 25$$

39 A, B, and C are in the firm for 12, 8, and 6 months respectively Rs 15,577 8a should be divided in proportion of

$$40\times12 \quad 3\times8 \quad 50\times6, \text{ or } 40 \quad 2 \quad 25$$

40 A, B, and C are in partnership for 3, 3, and $2\frac{1}{2}$ years respectively Rs 9660 must be divided in proportion of

$$8\times3 \quad 10\times3 \quad 6\times2\tfrac{1}{2}, \text{ or } 8 \quad 10 \quad 5$$

41 Suppose V_1, V_2 the volumes, s_1 and s_2 the specific gravities,

then by note at end of question, $\frac{W_1}{W_2}=\frac{V_1}{V_2}\times\frac{s_1}{s_2}$

$$=\tfrac{4}{5}\times\tfrac{5}{6}=\tfrac{2}{3},$$

giving 6 oz and 9 oz.

42 From note in No 41, weights are as $3\times7 \quad 2\times4 \quad 5\times2$,

i e as 21 8 10, giving 42 lbs, 16 lbs and 20 lbs.

43 The shares are as $\frac{1}{3}\times\frac{1}{4} \quad \frac{1}{4}\times\frac{1}{5} \quad \frac{5}{12}\times1$

i e as $\frac{1}{12} \quad \frac{1}{8} \quad \frac{5}{12}$, or as 2 3 10

44 The number of coins in each group is *jointly* proportional to the total value of the group directly, and to the value of each coin (in the group) inversely because the greater the total value of the group, the more coins we must have in it, but supposing the value of each coin is increased from a crown to a sovereign, there will be fewer coins in the group

no of coins in the different groups will be as

$$\tfrac{14}{20} \quad \tfrac{4}{7} \quad \tfrac{3}{20}, \text{ or as } 7 \quad 8 \quad 15$$

45 The volumes are proportional to weights taken directly and to specific gravities taken inversely

volumes are as $\frac{14}{20} \quad \frac{15}{30} \quad \frac{16}{40}$, *i e* as 7 5 4

Hence for second part of question we get 1 4 lit, 1 0 lit, 0 8 lit

EXAMPLES XVI h Page 327

1 2 4 in $\propto \frac{15}{8}$ 2 If x in be distance req^d, then $\frac{x}{144}=3\,5$

3 40 sq cm $\times \frac{25^2}{10^2}$

4 (i) 31 4 cm $\times \frac{7}{10}$, (ii) 314 sq cm $\times \frac{7^2}{10^2}$ 5 $80 \times \frac{63^2}{2\,5^2}$ sq yds

6 $13\,2 \times \frac{35^2}{2\,5^2}$ sq mi $=13\,2 \times 14^2$ sq mi $=2587\,2$ sq mi

7 (i) $\frac{145}{3^2}$ ft, (ii) $145 \times \frac{4^2}{3^2}$ [From Art 283, let $s=kt^2$

Now when $t=1$, $s=16\,1$ $k=16\,1$, and we get $s=16\,1t^2$]

8 3 28 lbs $\times \frac{1}{2^3}$ and 3 28 lbs $\times \frac{3^3}{2^3}$

9 Breadth $=6$ cm $\times \frac{12}{8}$ Thickness $=4$ cm $\times \frac{12}{8}$ Wt $=1\,4$ Kg $\times \frac{12^3}{8^3}$

10 Weight of first $=1\,30$ lbs $\times \frac{2\,5^3}{2^3}=1\,30 \times \frac{5^3}{4^3}$ lbs $=\frac{162\,5}{64}$ lbs

Weight of second $=1\,3$ lbs $\times \frac{7^3}{2^3}=\frac{445\,9}{8}$ lbs

11 Let N be no of revolutions required Since the no of revolutions in a given time varies inversely as diameter of the wheel,

$$\frac{N}{130}=\frac{12}{20}, \text{ whence } N=78$$

[The second wheel need not be taken into account]

12 Volume req^d $=1728 \times \frac{1\,4\,7}{8\,4}$ cu in

13 The first is paid 28s for 48 hrs and does 48×5, *i e* 240 units of work
The second „ 25s „ 54 hrs „ 54×4, *i e* 216 „ „
we have to compare the costs for 1 unit, viz $\frac{28}{240}s$ and $\frac{25}{216}s$
The latter is the smaller, giving 'the second man' for answer

14 $9d \times \frac{2\frac{1}{2}}{3} \times \frac{135\frac{1}{2}}{100}=10d$ and a small fraction

15 Let B put in Rs. x

A lends at the rate of [Rs 23250×4 + Rs 27000×8] for 1 month

B lends at the rate of [Rs $x \times 7$ + Rs $(x-3000) \times 5$] for 1 month

(See Ex. XVI g, No 36)

$7x+5(x-3000)=23250 \times 4+27000 \times 8$, whence $x=27000$

16 If W be weight req^d, then $\frac{W}{0\,00605}=\left(\frac{29\frac{1}{2}}{18\frac{1}{2}}\right)^2=\frac{59^2}{37^2}$,

from which $W=\frac{21\,00}{1369}=0\,01538$ gm

For second part of question,

difference is 0 00183 in 0 01355,

i e $\frac{183}{1355}$ in 100, or 13 5 %

17 If h be height req^d, then $\frac{h^3}{5^3}=\frac{1}{8}$, whence $h=2\frac{1}{2}$

18 We have $\frac{y}{16}=\frac{x^2}{8^2}$ or $y=\frac{1}{4}x^2$ Substituting the given values for x in turn in this equation, we find the corresponding values of y to be 0, $\frac{1}{4}$, 1, $\frac{9}{4}$, 4, $\frac{25}{4}$, 9, $\frac{49}{4}$

If the given values of x were negative, the resulting values of y would be positive (see Art 54), and would be 0, $\frac{1}{4}$, 1, $\frac{9}{4}$, 4, $\frac{25}{4}$, 9, $\frac{49}{4}$ The graph is shewn in Fig 15, on a reduced scale

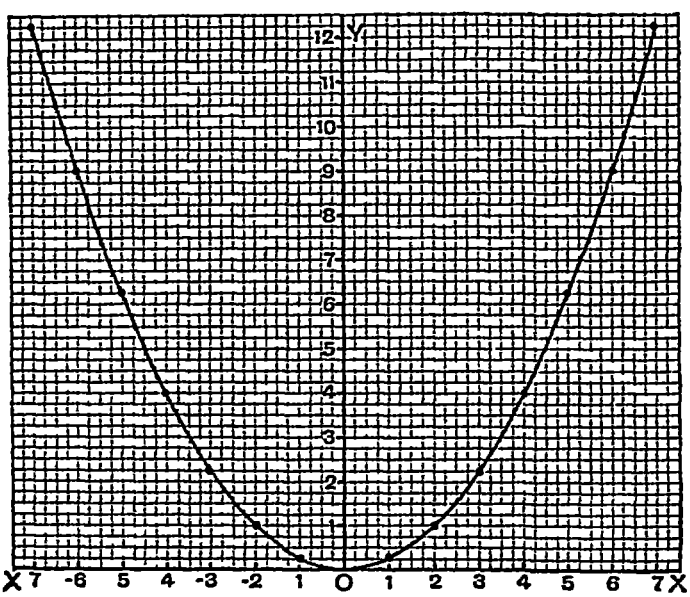

FIG 15

19 If we substitute the given values for C in turn in the equation, the corresponding values of S are found to be 0 1″, 0 4″, 0 9′, 1 6″, 2 5″, 3 6′, 4 9′, 6 4″ Taking a scale of 2 in along the axis of x to 1 in circumference, and 1 in along the axis of y to 1 ton, and plotting the points, we obtain a graph resembling the right-hand half of that in Ex 18 (Fig 15)

20 On completing the table, we shall find it convenient to take a scale of 0 1″ to a mile horizontally and 0 1″ to 0 125 lb vertically After plotting the points, we shall obtain a graph resembling the right-hand half of that in Ex 18 (Fig 15)

MISCELLANEOUS EXAMPLES IV Page 331

A

1 (i) Multiply numerator and denominator of first fraction by 45, it becomes $\frac{150-25+9}{120+13}$, *i e* $\frac{134}{133}$

Operate on second fraction in the same way with 15,

and it becomes $\frac{18}{105-35}$, *i e* $\frac{18}{133}$

(ii) Treating first fraction as in (i), we get

$$\text{exp}^{n}=\frac{64-13}{56+79}-\frac{0\,32}{1\,8}=\frac{17}{45}-\frac{16}{90}$$

3 40 mi per hr $=40\times\frac{88}{60}$ ft per sec (See p 60 of *Key*, Note on Ex XII b)

$=58\frac{2}{3}$ ft per sec

33 knots $=\frac{33\times6080}{60\times60}$ ft per sec

$=55\frac{11}{15}$ ft per sec

4 $\frac{2}{3}$ mi $-4000=\frac{2\times1760\times3\times12}{3\times4000}$ in $=10\,56$ in

5 Total length of a side $=35\times12$ in

No of tiles that can be placed $=\frac{372\times12}{8}=\frac{105}{2}=52\frac{1}{2}$,

52 complete tiles must be used, leaving a 2 in space at each end

As this holds good for all sides of the courtyard, we have a square piece of paving consisting of 52×52, or 2704 tiles

Uncovered space = area of courtyard − area of tiling

$=[(35\times12)^2-(52\times8)^2]=(420^2-416^2)=(420+416)(420-416)$

$=836\times4=3344$ sq in

B

7 Value = Rs 13 6875 × 20 4875

204 875	1 36875
204 875	
61 462	5
12 292	5
1 639	0
113	4
010	2
Rs 280 422	6

8 Exp^{n} $= 1\frac{4}{7} - \frac{2}{7} \times 1\frac{4}{5} + \frac{3}{10\,4} \times \frac{13}{6} \times \frac{16}{5} = 1\frac{4}{7} - \frac{1}{7} + \frac{1}{5}$

9 1 cwt. costs $£1\frac{1}{5} \times \frac{15}{16} + £1\frac{4}{5} \times \frac{1}{16}$ It is sold for $£\frac{15}{20} \times 112$,
the profit on 1 cwt. $= £(\frac{15}{20} \times 112 - 1\frac{1}{7} \times \frac{15}{16} - 1\frac{4}{5} \times \frac{1}{16}) = £3\frac{5}{12}$,
whence profit on 2 cwt 24 lbs $= £3\frac{5}{12} \times 2\frac{24}{112} = £\frac{185}{48} = £7\ 11s\ 4d$

10 £15 5 = (25 20 × 15 5) fr, or 390 6 fr

11 Amount req^{d} $= £\frac{3}{4} \frac{14}{10} \frac{25}{0} = £0\ 7\ 5 = 15s\ 1d$

12 If x be no of days req^{d}, then $\frac{25}{40} \times x = 12\frac{1}{2}$,
whence $x = 113\frac{1}{11}$, giving for result 111 days

C

13 13 % of 3 mds 30 srs $= \frac{13}{100}$ of 150 srs $= \frac{39}{2}$ srs $= 19\frac{1}{2}$ srs

14 $\frac{14\ 62}{83\ 1} + \frac{1\ 17\ 5}{13\ 85} = \frac{4\ 84}{27\ 7} + \frac{3\ 11}{7\ 7} = \frac{7\ 95}{27\ 7} = 0\ 288447$

15 Area $= \frac{330 \times 198}{4 \times 40} = 12\ 8$ ac, *i e* 13 ac. (to nearest acre)
Money req^{d} $= £17\ 1s\ 6d \times 6\frac{1}{2} + £21\ 15s\ 6d \times 6\frac{1}{2} = £39 \times 6\frac{1}{2}$
$= £253\ 10s$

16. We have $\frac{2 \text{ ac } 2 \text{ r } 7 \cdot 12 \text{ po}}{3\frac{1}{2} \text{ ac}} = \frac{(2 \times 4 \times 10 + 2 \times 40 + 7 \cdot 12) \text{ po}}{3\frac{1}{2} \times 1 \times 40 \text{ po}}$

$= \frac{407 \cdot 12}{560} = 0\ 727$

17. Ans $= (16\frac{1}{2} \times 1016 \cdot 05)$ Kg $= 16510\ 8$ Kg

18 *A* runs (28×5) yds while *B* runs (16×3) yds in 15 secs,
i e *A* „ 140 yds „ *B* „ 138 yds,
„ *A* „ 700 yds „ *B* „ $138 \times \frac{700}{140}$, or 690 yds

D

19 41 cu ft of teak weigh 2240 lbs,
1 „ „ $\frac{2240}{41}$ lbs, *i e* 54 lbs

20 Value $= £63\frac{3}{4} \times 0\,628125 = £\frac{191}{3} \times \frac{628\frac{1}{8}}{1000} = £\frac{191}{3} \times \frac{5025}{8000}$

$= £\frac{1979\,7}{32} = £39\ 19s\ 9\frac{3}{4}d$

21 Let A, B, C be the three numbers Using notation of Art 97, we have A B C $= mX\ nX\ pX = (mnp\ X) \times X^2 = 29172 \times 17^2$

22 Let x annas and $(x+5)$ annas per score be req^d prices
Then $25x + 25(x+5) = 625$, whence $x = 10$,

23 5 cwt 3 qr 20 lbs $= 664$ lbs, 2 cwt 16 lbs $= 240$ lbs,

value $= £44\frac{6\,4}{2\,4\,0} \times \frac{2\,4\,0}{6\,6\,4} = £16$

24 If A pays B Rs 90, B pays C Rs 90 and C pays A Rs 90, then they are in just the same position as before, for each pays and receives Rs 90 After this, however, A owes B Rs 35, B owes C Re 0, and A owes C Rs 23 They can therefore settle accounts by A paying B Rs 35 and C Rs 23

E

25 Area $= 3\frac{2}{3}$ acr big, expenditure $=$ Rs $440 \times 3\frac{2}{3}$ acr + Rs $3808\frac{3}{4}$

$=$ Rs $(1320 + 371\frac{1}{4} + 3808\frac{3}{4}) =$ Rs 5500

26 4 men and 9 boys do $\frac{5}{6}$ of work in 1 day,

8 „ 18 „ $\frac{5}{3}$ „ 1 „ (1)

Again 3 „ 6 „ $\frac{7}{12}$ „ 1 „

9 „ 18 „ $\frac{7}{4}$ „ 1 „ (2)

From (1) and (2) we see that 1 man does $(\frac{7}{4} - \frac{5}{3})$ of work in 1 day,
i e 1 man does $\frac{1}{12}$ of work in 1 day and would do the whole in 12 days

Again, since 3 men and 6 boys do $\frac{7}{12}$ in 1 day,

it follows that 6 boys do $(\frac{7}{12} - \frac{3}{12})$ in 1 day,

and 1 boy would do the whole in 18 days

Otherwise Let a man take x days and a boy y days,

then a man does $\frac{1}{x}$ in 1 day and a boy $\frac{1}{y}$ in 1 day,

$$\frac{4}{x} + \frac{9}{y} = \frac{5}{6}, \quad (1)$$

$$\frac{3}{x} + \frac{6}{y} = \frac{7}{12} \quad (2)$$

Multiplying (1) by 2, multiplying (2) by 3 and subtracting,

we get $\frac{1}{x}=\frac{1}{12}$, and $x=12$

Substituting the value of x in (1), we find $y=18$

27 Exp^n $=31\ 21325+3\ 20875-20\ 5375-13\ 632625$

$=34\ 122\qquad -34\ 170125$

$=0\ 251875=0\ 251\frac{7}{8}$

28 Let the cost of the Army be x per cent of the total

Then $\frac{x}{100}=\frac{91\ 710000}{183\ 592264}=\frac{91\ 7}{183\ 6}$(nearly)$=0\ 499$,

$x=49\ 9=50$ (to nearest integer)

Similarly for the Navy,

$$\frac{r}{100}=\frac{29{,}520{,}000}{183{,}592{,}264}=\frac{295}{1836}\text{(nearly)}=0\ 161,$$

$r=16\ 1=16$ (to nearest integer)

Also for the Civil Services,

$$\frac{x}{100}=\frac{23{,}500{,}000}{183{,}592{,}264}=\frac{235}{1836}\text{(nearly)}=0\ 128,$$

$x=12\ 8=13$ (to nearest integer)

29 Second man runs 5214 yds in 2133 secs,

i.e. $\frac{5214\times60\times60}{2133\times1760}$ mi in 1 hr,

or 5 mi in 1 hr

30 Let the third class fare be x shillings,

then the first-class fare is $(x+1\frac{1}{2})$ shillings,

$$325(x+1\tfrac{1}{2})+1250x=300\times20$$

Divide by 25, then $13(x+1\frac{1}{2})+50x=12\times20$, whence $x=3\frac{1}{2}$

F

31 (i) Exp^n $=\frac{\frac{5}{6}+\frac{3}{4}}{1\frac{1}{4}+2\frac{5}{12}}\times\frac{12}{12}+\frac{11}{34}$

$=\frac{20+9}{30+29}+\frac{11}{34}=\frac{3}{4}$

(ii) Exp^n $=\frac{\frac{11}{24}-\frac{5}{12}}{\frac{1}{48}+\frac{7}{16}-\frac{1}{6}}\times\frac{48}{48}=\frac{22-20}{1+9+8}=1$

32 It was seen twice in the first 13 secs, three times in the first 26 secs, and so on,

$$\text{req}^d\text{ no of times}=\frac{\text{total number of secs}}{13}+1$$

33 Let each man earn x annas, each boy y annas per day
Then „ $6x$ „ „ $6y$ „ per week,

$$\left.\begin{aligned} 6x\times 8+6y\times 4&=30\times 16,\\ \text{and } 6x\times 5+6y\times 3&=19\tfrac{1}{2}\times 16\end{aligned}\right\}$$

These become on reduction,

$$\left.\begin{aligned} 12x+6y&=120,\\ \text{and } 10x+6y&=101,\end{aligned}\right\} \text{ giving } x=8,\ y=4$$

35 From Ex 21, p 306, gross rental $=\frac{20}{19}$ of £7101 14s 6d

36 1 sov $\equiv\frac{480}{1869}$ oz $\equiv\frac{480\times 480}{1869}$ grs,
pure gold in 1 sov $=\frac{22}{24}$ of $\frac{480\times 480}{1869}=\frac{204800}{1869}=113$

G

37 See Arts 82 and 88

38 6897000 × 56 × 16 oz were produced per 187000 × 4840 sq yds,
i e $\frac{6897\times 56\times 16}{187\times 4840}$ oz „ „ 1 sq yd,
i e $\frac{1792}{935}$ oz, or 6 8 oz., were produced per 1 sq yd

39 Given price is £$\frac{47}{240}$ per $\frac{36}{39\ 3}$ metres,
i e $\frac{47}{240}\times 25\ 40$ fr per $\frac{36}{39\ 3}$ metres,
i e $\frac{47\times 25\ 40\times 39\ 3}{240\times 36}$ fr per metre,
i e $\frac{47\times 12\times 393\ 37}{120\times 36}$ fr per metre,
i e $\frac{2215}{4\ 12}$ fr, or 5 14 fr per metre

40 Exp^{n} $=$ £$1\frac{3741\ 6}{1\ 07}$ + £1 6875 × 0 58 − £0 9625 × 1 439
$=$ £(1 2658 + 0 9786 − 1 3850)
$=$ £0 859 $=$ 17*s* 2*d*

41 Total weight of 1 sov $=\frac{22}{11}$ of weight of pure gold in it,
1 sov weighs $113\times\frac{22}{11}$ gr,
and $\frac{11}{12\times 113}\times 7000$, or nearly 57 sovs weigh 7000 grs, or 1 lb Av

42 4060 yds remain, total no of men wanted during 2nd year is $1000\times\frac{4060}{2\ 9\ 8\ 0}$, giving 363 extra men

H

43 Take scales of an inch to 5 lbs horizontally and an inch to 5 Kg vertically As in Art 277, Example, $y=\frac{11}{11}x$ Join the point whose coordinates are (31, 11) to the origin The required values may be read off from the graph

44. Total debts=£715$\frac{1}{4}$. Hence he owes $\frac{315\frac{1}{4}}{715\frac{3}{4}}$ of £110 3*s* 3*d* to *A*, $\frac{255\frac{1}{2}}{715\frac{3}{4}}$ of £110 3*s* 3*d* to *B*, and $\frac{175}{715\frac{3}{4}}$ of £410 3*s* 3*d* to *C*

45. Let r be the no of concerts, then $5r=21\times 2\frac{1}{2}$,
whence $r=8\cdot4$, giving 9 as answer

46. Suppose x persons were admitted without payment
Then $(15568-x)$ paid 6*d*, and of these 1215 paid 1*s* extra,
$(15568-x)\times 6+1215\times 12=101610$ (receipts in pence),
and $x=1123$

47. 71 ac 1 r 15 po $=(71+0\cdot25+0\cdot09375$

71·343	75
	2·625
112·687	5
12·806	2
1·426	9
·356	7
£187·277	3

giving £187 5*s* 7*d*

48. No of men necessary to do the required work is $7\times2\times3$, or 42,
we must replace 12 of these by boys,
hence $\frac{5}{2}$ of 12, or 30 boys are required

I

49. If A sq in be area req^{d}, then expressing the volume in cu in,
$8\times36\times A=3\times1728$, and $A=18$ sq in

50. Take a scale of 0·4″ to 1 rupee horizontally, then each 0·1′ represents 4*a*, and an estimate correct to the nearest 1*a* can easily be made. A scale of 0·5″ to 1 *si* vertically should be taken. If y sis cost x rupees, as in Art 277, Example, since Rs 92 8*a* = Rs $\frac{185}{2}$ and 1 md = 40 sis, $y=\frac{80}{185}x$. This may be written $y=\frac{16}{37}x$, or $y=\frac{12}{7}x$. Take for origin the point (16, 37) and join it to the point (32, 71) by a straight line. From this graph the required values may be read off

51 3 men *or* 7 women will take 64 days to do a piece of work twice as great

Now 7 men *and* 5 women take 7 times as long as 49 men *and* 35 women,

i e 7 men *and* 5 women take 7 times as long as 49 men *and* 15 men,

i e 7 men *and* 5 women take 7 times as long as 64 men,

i e 7 men *and* 5 women take 64 days $\times \frac{7}{64} \times 7$, or 21 days

N B 35 is the L C M of 5 and 7,

35 women can be replaced by an exact no of men

52 15 oz cost $11\frac{1}{4}$ a, 16 oz cost $\frac{16}{15}$ of $11\frac{1}{4}$ a

53 Let s ft be length of train, v ft per sec be its speed

From Art 214, $s + 132 \times 3 = v \times 7\frac{1}{2}$, ... (1)

$s = v \times 3$ (2)

Subtracting (2) from (1), $396 = v \times 4\frac{1}{2}$, and $v = 88$ ft per sec, giving 60 mi per hour

54 (Draw a diagram)

$$\text{Cost in annas} = 8 \times (25\tfrac{1}{2} \times 19\tfrac{17}{44} - 21\tfrac{1}{2} \times 16\tfrac{21}{44}) + \tfrac{64}{9} \times 21\tfrac{1}{2} \times 16\tfrac{21}{44}$$

$$= 8 \times 25\tfrac{1}{2} \times 19\tfrac{17}{44} + (\tfrac{64}{9} - 8) \times 21\tfrac{1}{2} \times 16\tfrac{21}{44}$$

$$= 8 \times \tfrac{51}{2} \times \tfrac{469}{24} - \tfrac{8}{9} \times \tfrac{43}{2} \times \tfrac{137}{8}$$

$$= \tfrac{79073}{2} - \tfrac{847}{2} = 3664$$

cost = Rs 229

J

56 (i) $\text{Exp}^n = \dfrac{\frac{1}{3} \times \frac{4}{3} \times \frac{8}{5}}{\frac{4}{5} + 2\frac{2}{5}} = \dfrac{32}{144}$

(ii) $\text{Exp}^n = \dfrac{\frac{3}{14} - \frac{12}{1443}}{12\frac{1}{11} - 11\frac{1}{14} - \frac{17}{60}} = \dfrac{231}{\frac{673}{88}}$

57 (Draw diagram) Area of path $= (82 \times 75 - 74 \times 67)$ sq ft, which reduces to 132 sq yds 4 sq ft

58 A does in 8 days what B does in 15 days and what C does in 12 days,

B's time $= A$'s time $\times \frac{15}{8} = 12$ wks $\times \frac{15}{8}$

59 Take scales of 1" to 0 2 Kg horizontally, and 0 2" to 1 lb vertically As in Art 277, Example, $y = \frac{27}{19} x$, or $y = \frac{14}{38} x$ Take for origin the point (1 9, 27) Join it to the point (3 8, 54) From this graph the required values may be read off

60 27 mds 5 srs = 1085 sis

$$\text{Cost} = 209\text{ a} \times \frac{46\frac{1}{2}}{52\frac{1}{4}} \times \frac{700 \times 40}{1085} = 4800\text{ a} = \text{Rs } 300$$

K.

61 22 cwt 3 qrs 21 lbs = 22 9375 cwt

£12 16*s* 8*d* = £12 83333

22 937	5
1	2 8333333
229 375	
45 875	
18 350	
688	1
68	8
6	9
	7
	1
£294 364	6

N B It is easier to multiply by the money, on account of the '3's' recurring

giving £294 7*s* 3½*d*

62 $\text{Exp}^{n} = \frac{1 + \frac{2}{3} - \frac{17}{20}}{1 + \frac{1}{3} - \frac{8}{15}} \times 6\frac{6}{7} = \frac{60 + 40 - 51}{60 + 20 - 32} \times \frac{48}{7}$

63 4,41,00 01,5 (210 00004

41 | 41

42,0,0 | 00 01 5

64 Using notation of Ex 2, page 330, we get

$$3(x+y) = 27 \text{ and } 9(x-y) = 27$$

These give $x+y=9$ and $x-y=3$

Adding, we find $x=6$, whence $y=3$

Answer for (ii) $= \frac{27}{6} = 4\frac{1}{2}$ hours

65 1½ pints in 1 min = 3 gallons in 16 min $= \frac{3}{16} \times 60$ gals in 60 min

$= \frac{3}{16} \times 60 \times \frac{1}{0\ 2\ 2\ 0\ 1}$ lit in 1 hour,

i e $\frac{45}{0\ 8\ 8\ 0\ 4}$ lit, or 51 lit in 1 hr

66 His time must be greater in the ratio 1760 1710

(See Arts 269 and 270)

$$\text{time required} = \left(3\frac{25\frac{1}{5}}{60} \times \frac{1760}{1710}\right) \text{min} = 3\frac{2}{5}\text{ min} = 3 \text{ min } 31\frac{1}{5} \text{ secs}$$

L

67 Let a seer cost x annas, then $\frac{3x}{2}\times 6+x=35$, and $x=3\frac{1}{2}$

68 Required sum is £183 3s 10d $\times\frac{14s\ 7\frac{1}{4}d}{£1}$

$=£183\,692\times 0\,730208$

$=£134\ 2s\ 8d$

183 692	0·730208
128 584	4
5 510	8
36	7
1	4
£134 133	3

69 (1600×9) sq ft cost Rs 165,

(80×1760×3) sq ft cost Rs $165\times\frac{80\times 1760\times 3}{1600\times 9}$, or Rs 4840

70 1320 yds or $\frac{3}{4}$ mi $=18\frac{3}{4}$ in, whence 1 mi $=25$ in,

1 sq mi $=625$ sq in, giving second answer

71 (i) Product $<4\times 0\,9$, *i e* 3 6

(ii) Quotient $>\frac{3\,084}{0\,9}$, *i e* 4 4

(iii) From Art 226, p 246, we see that first figure in $\sqrt{0\,324}$ is 0 5

72 Total expenditure $=$ Rs 2 13 a 6 p $\times 122=$ Rs 346 15 a

Expenditure in Sept	= Rs 3 5 a	× 30 =	Rs 99 6 a
„ Oct	= Rs 2 8 a	× 31 =	Rs 77 8 a
„ Nov	= Rs 1 15 a	× 30 =	Rs 58 2 a
expenditure in Dec	= Rs 111 15 a		

This will give Rs 3 10 a as answer

M

73 (24 25×16 8) sq ch $=$(2 425×16 8) ac,

rent $=£5\,775\times 2\,425\times 16\,8=£(14\,00438\times 16\,8)=£235\,2735$

74 13 men *and* 15 boys take 16 times as long to hoe a piece of ground as 13×16 men *and* 15×16 boys take, or as 13×16 men *and* 15×9 men take, or as (208+135) men, *i e* 343 men take

req^{d} no of days $=7\times\frac{0}{343}\times\frac{40}{10}\times\frac{10}{9}\times 16=10$

Alter If we work with a fraction of a man,

since 1 boy $=\frac{9}{10}$ of a man,

we have 13 men and 15 boys $=(13+\frac{15\times 9}{10})$ men, *i e* $21\frac{7}{10}$ men

no of days required $=\left(7\times\frac{10}{9}\times\frac{49}{16}\times\frac{9}{21\frac{7}{10}}\right)=10$

75 Let A, B and C get Rs x, Rs $3x$ and Rs $4x$ respectively,

$$x+3x+4x=7852\frac{1}{2}, \text{ and } x=981\frac{9}{16}$$

A gets Rs 981 9 a, etc.

76 See Ex 2, p 227 Velocity of approach $=(60+40)$ Km, $i.e.$ 100 Km

Sum of lengths $=175$ m,

$$\text{time req}^{d}=\frac{175}{100\times1000} \text{ hours, } i.e. \ 0{\cdot}00175 \text{ hrs, or } 6\,3 \text{ secs}$$

For second part of question, we get velocity of approach $(60-40)$ Km., $i.e.$ 20 Km, giving time req^{d} as 31 5 secs

77 Let x ft be thickness of beam

$$9x^2\times32=3\frac{1}{2}\times112, \text{ whence } x=1\tfrac{1}{6} \text{ ft}$$

78 Take scales of 1 in to 10 oranges horizontally, and 1 in to 20 a vertically Since Rs 3 2 a $=50$ a, as in Art 277, Example,

$$y=\tfrac{50}{64}x, \text{ or } y=\tfrac{10}{13}x$$

Join the point whose coordinates are (13, 10) to the origin From this graph we can read off the required values

N

79 1 cu ft. of water $\equiv(30\,48)^3$ gms,

$$62\,426 \text{ lbs} \equiv(30\,48)^3\times0\,001 \text{ Kg},$$

$$1 \text{ Kg} \equiv\frac{62426}{(30\,48)^3} \text{ lbs, } i.e. \ \frac{62426}{28320} \text{ lbs, } i.e. \ 2\,2 \text{ lbs}$$

80 Wt $=1\,6\times5\frac{9}{32}\times2\frac{7}{8}\times1\frac{5}{16}$ oz $=\frac{7872}{256}$ oz $=30\,75$ oz

As a simple test, take block to be $(5\times3\times1\frac{1}{4})$ cu in, it then weighs 30 oz

81 (See Ex 2, p 330) Let x miles per hour be rate of stream and y miles the distance rowed

Then $y=7(8-x)$ Also $y=5(8+x)$,

$$7(8-x)=5(8+x), \text{ whence } x=1\tfrac{1}{3}$$

82 Let each man construct x yards per day
Then, if y yards be length of path,

$$3x \times 2 = \frac{y}{5} - 1760, \quad (1)$$

$$\text{and} \quad 18x = \frac{2y}{5} - 1760 \quad (2)$$

Adding (1) and (2), $24x = \frac{3y}{5}$, and $6x = \frac{3y}{20}$

Substituting this value for $6x$ in (1),

we have $\frac{3y}{20} = \frac{y}{5} - 1760$, and $y = 1760 \times 20$, *i e* 20 miles

83 Let l ft be length of train and v ft per sec be velocity of train
Since 2 miles an hour $= \frac{88}{30}$ ft per sec, and 4 miles an hour $= \frac{88}{15}$ ft per sec, velocity of approach of first person and train $= v - \frac{88}{30}$, of second person and train $= v - \frac{88}{15}$

From Ex 2, p 227, we see time req^d $= \frac{\text{length}}{\text{velocity of approach}}$,

or length = velocity of approach × time req^d,

$$l = (v - \tfrac{88}{30}) \times 9, \text{ also } l = (v - \tfrac{88}{15}) \times 10,$$

$10(v - \frac{88}{15}) = 9(v - \frac{88}{30})$, and $v = \frac{484}{15}$ ft per sec,
or 22 mi per hour

84 The equation to OP is $y = \frac{14\,14}{10} x$,
or $y = 1\,414x$ Cf Art 275

O

85 (3+15+105) times, *i e* 123 times $93 = 105 - 15 + 3$

86 Let d ft be the required depth Then weight of water
$= 1000 \times 24 \times 15 \times d$ oz, and also $= 9000 \times 10 \times 16$ oz
Since these are equal, we find $d = 4$ ft

87 Time req^d $= 23 \times 7 \times \frac{200}{280} \times \frac{18}{15}$ days, *i e* 138 days

88 Let 1 seer cost x annas At higher price 1 seer costs $(x + 1\frac{1}{4})$ annas,

$15\frac{1}{2}$ chk cost $\frac{15\frac{1}{2}}{16}(x + 1\frac{1}{4})$ annas,

$\frac{15\frac{1}{2}}{16}(x + 1\frac{1}{4}) = x$, and $x = 38\frac{3}{4}$ a

89 For second part of question, total height of the four men
$=(1\cdot72\pm\cdot005)\times4$ m $=(6\cdot88\pm\cdot02)$ m
Total height of the three $=(1\cdot8+1\cdot65+1\cdot58\pm\cdot005\times3)$ m
$=(5\cdot03\pm\cdot015)$ m
Difference $=(1\cdot85\pm\cdot035)$ m, giving for limits 1 815 m, and 1 885 m

90 (i) Area $=[(11\cdot4)^2-(8\cdot6)^2]\times0\cdot7854$ sq ft $=43\cdot97$ sq ft
$=44$ sq ft

(ii) Weight $=6\cdot7\times[(7\cdot3)^2-(4\cdot7)^2]\times0\cdot7854$ gm $=164\cdot18$ gm
$=164$ gm

P

91 Let x runs be average required
Then $12\times24+3x=15\times30$, and $x=54$

92 (i) Cost $=$ Rs 5 11a $\times87+$14a 6p $\times2\times87$
$=$(Rs 5 11a + Re 1 13a)$\times87=$ Rs 7 8a $\times87=$ Rs 652 8a

(ii) 8250 at Rs 7 14a per 1000 $=8\frac{1}{4}$ at Rs 7 14a each $=$ etc

(iii) $(49\frac{7}{10}\times\frac{1}{2})$ mi $=(50-\frac{3}{10})\times\frac{1}{2}$ mi $=25$ mi $-\frac{3}{20}$ mi
$=25$ mi -495 yds $=24$ mi 1265 yds

93 Cost $=[2\times(5\frac{1}{2}+4)\times3+5\frac{1}{2}\times4]\times8$a $=79\times8$a $=$ Rs 39 8a

94 (3 5 × 7 4) sq in. $=12535\frac{7}{3500}$ sq mi

$$1 \text{ sq in} = \frac{12535\frac{7}{3500}}{3\cdot5\times7\cdot4} \text{ sq mi}$$

Now $\frac{7}{3500}<0\cdot001$, $\frac{7}{3500}-(3\cdot5\times7\cdot4)<0\cdot0001$
the square root of this is 0 01

This shews $\frac{7}{3500}$ may be neglected

1 sq in $=\frac{12535}{3\cdot5\times7\cdot4}$ sq mi $=483\cdot9$ sq mi, *i e* 484 sq mi
scale is 1 in to 22 mi, since $484=22^2$

95 Let him row x mi per hour on still water
Then $21=3\frac{1}{2}(x-2)$, and $x=8$
time required $=\frac{20}{8+2}$ hrs., *i e* 2 hrs

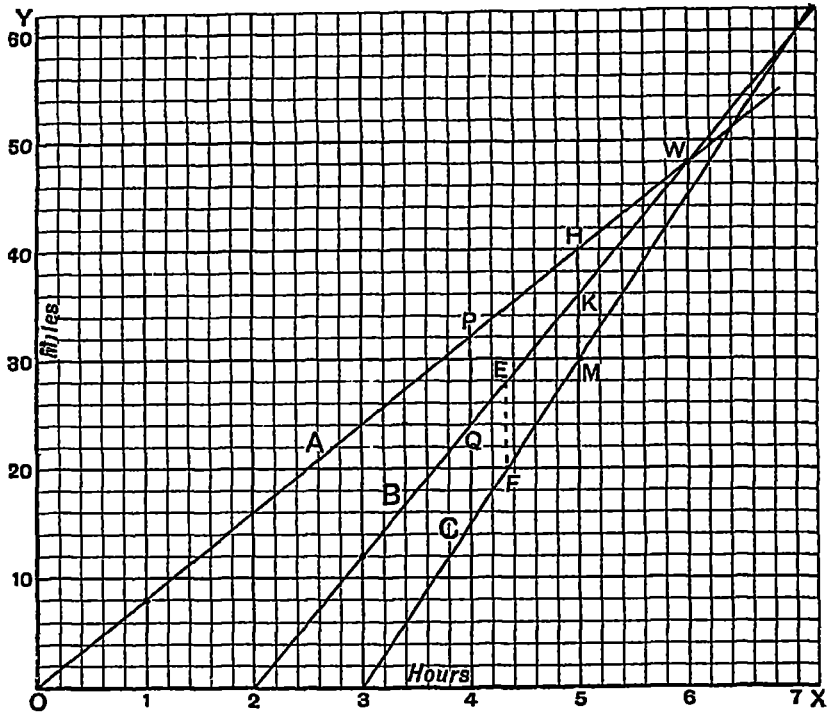

FIG 16

96 See Fig 16, which is drawn on half the given scale The line is such that each ordinate is numerically eight times the corresponding abscissa ' 'Also the distance travelled at 8 mi per hr in any number of hours is 8 times that number of hours Hence the ordinate of any point on the line gives the distance travelled in the time indicated by the abscissa of that point

The graph of A's motion is the line OPH

Since B starts at 2 p m at 12 mi per hr and has therefore gone 12 mls at 3 p m , his graph will be the line obtained by joining the points (2, 0) and (3, 12) Similarly C's is obtained by joining (3, 0) and (4, 15)

The time and place of B's overtaking A are given by the coords of the point common to their graphs, viz W, and are 6 p m and 48 mls from O

To find at what times A and B are 8 mi apart, we must discover

for what abscissæ the vertical distance between the two graphs represents 8 m This will be the case for the abscissæ marking 4 p m and 8 p m (The latter is not shewn in the diagram)

The rest of the solution will be obvious from the figure

EXAMPLES XVII a Page 341

1 and 2 See Art 287, Ex 1

3 Let x be rate per cent, then $\frac{x}{100}=\frac{31}{25}$ 4–6 As No 3

7–12 See Art 287, Ex 2 13–16 As No 3

17 Let r be the rate per cent, then $\frac{x}{100}=\frac{38}{271}$, and $r=14\,0$

18–21 As No 17 22 Req^d value $=\frac{4}{100}$ of £573 $=$ £22 920

23–24 As No 22 25 Req^d value $=\frac{4\frac{1}{4}}{100}$ of £584 $=$ £2 499

26 Req^d value $=\frac{4}{100}$ of £150 675 $=$ £6 0s 6d

27 Req^d value $=\frac{5\frac{1}{4}}{100}$ of £804 4 $=$ £46 253

28 (i) Req^d value $=\frac{1}{100}$ of £302 729 $=$ £9 08187

(ii) Req^d value $=\frac{5\frac{1}{4}}{100}$ of £1572 11s 10d $=\frac{11}{200}$ of £1572 11s 10d

$=\frac{11}{100}$ of £786 5s 11d $=\frac{1}{100}$ of £8649 5s 1d

$=$ £86 49251

29 Req^d commission $=\frac{3\frac{1}{2}}{100}$ of Rs 3750

30 Error $=\frac{\frac{1}{4}}{36}$ of length $=\frac{1}{144}$ of length

If x be req^d percentage, $\frac{x}{100}=\frac{1}{144}$, and $x=0\,694$

31 Loss $=1141$ in 7500 or $\frac{1141}{7500}$ in 100, giving $\frac{1141}{75}$, or 15 2 %

32 Increase is 268 on 4680, or $\frac{2680}{4680}$ on 100, giving 5 7 %

EXAMPLES XVII b Page 344

N B In some of these examples x is used for the quantity to be found

1 If Rs r be his income, $\frac{77\frac{1}{2}}{100}$ of Rs r is left, $\frac{77\frac{1}{2}r}{100}=$ Rs 1860

2 Req^{d} population $=\frac{84}{100}$ of 15800

3 From Art 289, $x\times\frac{109}{100}$ is the present population,

$$x\times\frac{109}{100}=62{,}130$$

4. From Art 289, first rem^{r} $=\frac{87\frac{1}{2}}{100}$ of 145600,

$$x=\frac{85}{100}\text{ of }\frac{87\frac{1}{2}}{100}\text{ of }145600$$

5 $x=\frac{90}{100}$ of 7 a 6 p 6 From Art 289, $\frac{80}{100}$ of $x=140$ (pence)

7 First remainder $=\frac{5}{7}$ of x, from Art 289, $\frac{64}{100}$ of $\frac{5x}{7}=95880$

8 $\frac{95}{100}$ of $x=532$ 9 As in 8, $\frac{92\frac{1}{2}x}{100}=74000$

10 From Art 289, a year ago the fund stood at $\frac{112}{100}$ of Rs x,

it will now stand at $\frac{112}{100}$ of $\frac{112}{100}$ of Rs x,

$\frac{112}{100}$ of $\frac{112}{100}$ of Rs $x=$Rs 157584

11 Let a represent 182 460, then $a-x=\frac{5\frac{1}{2}a}{100}$,

$$x=a-\frac{5\frac{1}{2}a}{100}=\frac{94\frac{1}{2}a}{100}=\frac{94\cdot5\times182\,460}{100}$$

12 Increase=Rs 177280 on Rs 4780320, *i e* $\frac{177280}{4780320}\times100$ on 100, giving 3 71 %

13 Applying the principle of Art 289, we have

$x\times\frac{200}{100}\times\frac{80}{100}\times\frac{80}{100}\times\frac{80}{100}=\frac{1024}{100}\times x$, giving 2 4 %

14 $\frac{x}{100}=\frac{57900000}{1440000000}$

15 Yield of olives per ac $=\frac{15000000}{432000}$ lbs $=35$ lbs,

„ currants „ $=\frac{3500000000}{108000}$ lbs $=2083$ lbs,

„ figs „ $=\frac{600000000}{52000}$ lbs $=1154$ lbs

If percentage of land occupied by olives is x,

then $\frac{x}{100}=\frac{432000}{5503100}$, and $x=\frac{432000\times100}{5503100}=8$

Similarly percentage of land occupied by currants

$=\frac{168000\times100}{5503100}=3$,

„ „ „ „ figs $=\frac{52000\times100}{5503100}=1$

16 Total imports = £523075163

As in No 15 we obtain

percentage for British possessions $= \frac{109530675 \times 100}{5230751 \cdot 63} = \frac{10953}{523} = 21$

„ U S $= \frac{138880861 \times 100}{5230751 \cdot 63} = \frac{13888}{523} = 27$,

„ France $= \frac{53618656 \times 100}{5230751 \cdot 63} = \frac{5361}{523} = 10$,

„ other countries $= \frac{221176611 \times 100}{5230751 \cdot 63} = \frac{22114}{523} = 42$.

17 As in No 15 we obtain

percentage for 1868 $= \frac{1054448 \times 100}{1568044} = \frac{10544}{156} = 67$,

„ 1869 $= \frac{1016106 \times 100}{1540116} = \frac{10161}{154} = 66$,

„ 1870 $= \frac{5473460 \times 100}{8471156} = \frac{54735}{847} = 65$

For whole period percentage $= \frac{\text{total expenses} \times 100}{\text{total earnings}}$

$= \frac{16304014 \times 100}{4711881} = \frac{16304}{471} = 66$

18 As in No 15 we obtain

percentage increase for England and Wales

$= \frac{35131816 \times 100}{2900525} = \frac{3513}{290} = 12$,

„ „ Scotland $= \frac{4456456 \times 100}{402504} = \frac{44564}{4025} = 11$

19 As in No 15 we obtain

percentage for England and Wales $= \frac{1037000 \times 100}{33378000} = \frac{1037}{334} = 15$,

„ Scotland $= \frac{6600000 \times 100}{45000000} = \frac{6600}{450} = 15$,

„ Ireland $= \frac{48000 \times 100}{4414000} = \frac{4800}{441} = 11$

EXAMPLES XVII c Page 347

1-5 See Art 291, Ex 1 6-9 See Art 291, Ex 2

10 Profit = (Re 1 2a 9p − 15a) = 3a 9p on 15a,

$$\text{req}^{\text{d}} \text{ percentage} = \frac{3\text{a. } 9\text{p}}{15\text{a}} \times 100 = 25$$

11 Loss = 18s on (£3 2s + 18s), or 18s on £4,

$$\text{req}^{\text{d}} \text{ percentage} = \frac{18s}{£4} \times 100 = 22\tfrac{1}{2}$$

12 CP − 4% of CP = SP, or $\frac{96}{100}$ of CP = SP,

SP = $\frac{96}{100}$ of Rs 75 = Rs 72

13 SP = CP + 14% of CP, or SP = $\frac{114}{100}$ of CP = $\frac{114}{100}$ of 100a

= Rs 7 2a

14 C P $-12\frac{1}{2}\%$ of C P = S P, $\frac{87\frac{1}{2}}{100}$ of C P = Rs $2\frac{5}{8}$,

C P = Rs $2\frac{5}{8} \times \frac{100}{87\frac{1}{2}}$ = Rs 3

15 (i) Profit = £3 7*s* 1*d* on £40,

req^{d} percentage = $\frac{£3\ 7s\ 1d}{£40} \times 100 = \frac{3\,3\,5\,4}{4\,0} = 8\,4\%$ gain

(ii) Loss = £3 10*s* 5*d* on £25 15*s*,

req^{d} percentage = $\frac{£3\ 10s\ 5d}{£25\ 15s} \times 100 = \frac{3\,7\,2\,1}{5\ 7\ 5} = 13\,7\%$ loss

(iii) Profit = £9 13*s* $0\frac{1}{2}d$ on £77 4*s* 8*d*,

req^{d} percentage = $\frac{£9\ 13s\ 0\frac{1}{2}d}{£77\ 4s\ 8d} \times 100 = \frac{9\,6\,5\,2}{7\ 7\ 2\,3\,3} = 12\,5\%$ gain

16 $5\frac{3}{4}d$ per lb = 664*d* per cwt, £2 7*s* 11*d* = 575*d*

gain per cent = $\frac{(644-575)d}{575d} \times 100 = 12$

17 C P per 100 = $\frac{1\,5}{1\,2} \times 100$ a,

S P per 100 = $\frac{1\,1\,2}{1\,0\,0}$ of $\frac{1\,5}{1\,2} \times 100$ a = Rs 8 12 a

18 C P for 130 lbs = 32*s* 6*d*, gain per cent = $\frac{4s\ 10\frac{1}{2}d}{32s\ 6d} \times 100 = 15$

19 110 knives cost Rs 100, and are sold for Rs 121,

gain per cent = 21

20 For 25 eggs, C P = 15 a, and S P = 18 a,

gain per cent = $\frac{3}{15}$ of 100 = 20

21 If it cost x annas, then $\frac{92r}{100} = 92$ a, and $r = 100$ a

22 If it cost x rupees, then $\frac{120x}{100} = 15$, and $r = $ Rs $12\frac{1}{2}$

23 If £x be C P, then $\frac{107\frac{1}{2}x}{100} = 17\frac{1}{5}$, and $x = £16$

24 If Rs x be C P, then $\frac{90r}{100} = 65\frac{1}{4}$, and $r = $ Rs $72\frac{1}{2}$

25 150 yds at 8 a 9 p per yd are worth Rs 82 0 a 6 p = Rs 82 03125

If Rs x be C P, $\frac{125x}{100} = 82\,03125$, and $x = $ Rs 65 625

26 9*d* per doz = 15*d* per score if x pence be C P,

$\frac{120r}{100} = 15$ and $r = 12\frac{1}{2}d$

27 Let x pence be C P per lb, then $\frac{112\frac{1}{2}x}{100} = 2\frac{1}{4}$, and $x = 2d$,

cost per ton = 2*d* × 2240 = £18 13*s* 4*d*

28 Let £x be C P per gross, then $\frac{85x}{100}=20\,4$, and $x=$£24
His S P must be $\frac{120}{100}$ of £24, or £28 16s

29 Let x shillings be C P per half cwt, then $\frac{93\frac{3}{4}x}{100}=105$, and $x=112s$,
C P per lb $=2s$

EXAMPLES XVII d Page 350

1 Req^{d} S P $=\frac{110}{100}$ of Rs 361

2 Req^{d} S P $=\frac{105}{100}$ of 19s

3 Req^{d} S P $=\frac{108}{100}$ of Re 1 9a 9 p

4 Req^{d} S P $=\frac{100}{96}$ of $2\frac{1}{2}d\times112=$£1 5s

5 Since Rs 81 $=\frac{72}{100}$ of C P, Rs 90 $=\frac{90\times72}{81\times100}$ of C P $=\frac{80}{100}$ of C P, hence loss is 20 %

6 105a $=\frac{105}{100}$ of C P, 93a $=\frac{93}{100}$ of C P, giving 7 % loss

7 43a $=\frac{107\frac{1}{2}}{100}$ of C P, 38a $=\frac{107\frac{1}{2}}{100}\times\frac{38}{43}$ of C P $=\frac{95}{100}$ of C P, and loss is 5 %

8 Let x annas be req^{d} price, then $\frac{90x}{100}=99$, and $x=110a=$Rs 6 14a

9 If he bought at x annas per score, he paid $10x$ annas
He received $\frac{11}{12}\times180a$ $\frac{108}{100}\times10x=180\times\frac{11}{12}$, whence $x=30a$

10 $2\frac{3}{4}d$ per lb $=308d$ per cwt, $308d=\frac{88}{100}$ of C P,
hence £1 11s 6d, or $378d=\frac{88}{100}\times\frac{105}{100}$ of C P $=\frac{108}{100}$ of C P, giving 8 % profit

11 She sells 108 oranges for 90a, and since her loss is 10 %, then C P is 100a If she sold them at 10 for 12a, she would receive 129 6a, giving a profit of 29 6 %

[*N B* The *number of oranges sold* does not affect the gain or loss per cent 108 is a convenient number because the first S P is then 90a, which at once gives 100a as the C P]

12 24a $=\frac{128}{100}$ of C P, 21a $=\frac{112}{100}\times\frac{21}{24}$ of C P, or $\frac{112}{100}$ of C P, giving 12 % profit

13 Let £x be cost price, then $\frac{112x}{100}=49\,8$, and $x=$£415

14 Let Rs x be cost price, then $\frac{20x}{100}=7\ 5$, and $x=$Rs 37 5
(See note to no 13)

15 Let £x be cost of carriage, then $\frac{30x}{100}=10$, and $x=£33\frac{1}{3}$
(See note to no 13)

16 Let x rupees be prime cost, then $\frac{20x}{100}=9\frac{3}{8}$, and $x=$Rs $46\frac{7}{8}$
(See note to no 13)

17 Let x pence be C P, then $\frac{22x}{100}=44$, and $x=200d$,
$\frac{88}{100}$ of C P $=176d=14s\ 8d$ (See note to no 13)

18 Let x shillings be C P per doz, then $\frac{12\frac{1}{2}x}{100}=5$, and $x=40s$,
S P req$^{d}=\frac{120}{100}$ of $40s=48s$ (See note to no 13)

19 See Art 293 It costs C Rs $600\times\frac{110}{100}\times\frac{105}{100}$, or Rs 693

20 See Art 293 I must pay £$3\ 2\times\frac{125}{100}\times\frac{112\frac{1}{2}}{100}$, or £4 10$s$

21 See Art 293 He pays Rs $2000\times\frac{84}{100}\times\frac{125}{100}$, or Rs 2100

23 Let x shillings be A's cost, then $x\times\frac{110}{100}\times\frac{110}{100}=121$, or $x=100$

24 He got $40d\times\frac{120}{100}\times\frac{125}{100}\times\frac{95}{100}$, or $57d$

25 C P to dealer $=\frac{125}{100}$ of Rs $160=$Rs 200, profit $=$Rs 50, $i.e.$ 25 %

26 Shopkeeper pays $\frac{110}{100}$ of first price, and sells at $\frac{121}{100}$ of first price, his gain is $\frac{11}{100}$ of C P on outlay of $\frac{110}{100}$ of C P, or 10 %

Alter If article first cost £100, dealer paid £110 and sold at £121 profit is £11 on £110, or 10 %

27 Let x be profit per cent Third S P $=\frac{157\frac{1}{2}}{100}$ of first S P

Also third S P $=\frac{120}{100}$ of $\frac{125}{100}$ of $\frac{100+x}{100}$ of first S P,

$\frac{120}{100}\times\frac{125}{100}\times\frac{100+x}{100}=\frac{157\frac{1}{2}}{100}$, $i.e.$ $100+x=\frac{157\frac{1}{2}\times100\times100\times100}{100\times120\times125}$,
whence $x=5$

28 Let B make x %, then £$6\times\frac{125}{100}\times\frac{100+x}{100}\times\frac{110}{100}=£9\ 9$,

$100+x=\frac{9\ 9\times100\times100\times100}{6\times125\times110}$, and $x=20$

29 (i) Req^{d} price $=75d \times \frac{105}{100} \times \frac{110}{100} = 99d = 8s\ 3d$

(ii) Req^{d} price $=25s \times \frac{120}{100} \times \frac{110}{100} \times \frac{112\frac{1}{2}}{100} = \frac{297}{8}s = £1\ 17s\ 1\frac{1}{2}d$

(iii) If $£x$ be cost req^{d}, then $£x \times \frac{120}{100} \times \frac{110}{100} \times \frac{112\frac{1}{2}}{100} = £14\ 85$,

$$x = 14\ 85 \times \frac{100}{120} \times \frac{100}{110} \times \frac{100}{112\frac{1}{2}}, \text{ or } £10$$

(iv) If r be profit per cent, then $\frac{100+r}{100}$ of C P $= \frac{120}{100} \times \frac{110}{100} \times \frac{112\frac{1}{2}}{100}$,

$$\frac{100+r}{100} = \frac{120 \times 110 \times 112\frac{1}{2}}{100 \times 100 \times 100}, \text{ and } 100+x = 148\tfrac{1}{2}, \text{ or } x = 48\tfrac{1}{2}$$

EXAMPLES XVII e Page 353

1 Let x be req^{d} population, adding the births and subtracting the deaths, $x + \frac{11x}{100} - \frac{4x}{100} = 85600$, and $x = 80000$

$$\text{births} = \frac{11x}{100} = 8800, \text{ deaths} = \frac{4x}{100} = 3200$$

2 Total C P $= (8 \times 25 + 20 \times 20)s = 600s$ Total S P $= 28 \times 21s = 672s$
gain is $72s$ on $600s$ outlay, or $12s$ on $100s$, giving 12 %

3 Suppose 4 lbs of chicory are mixed with 17 lbs of coffee
Total C P $= (4 \times 3 + 17 \times 24)$a $= 420$a Total S P $= 21 \times 25 = 525$a
gain is 105a on 420a, or $\frac{105 \times 100}{420}$a on 100a, giving 25 %

4 Capital req^{d} $=$ Rs $10000 \times \frac{105}{100} \times \frac{105}{100} \times \frac{105}{100} \times \frac{105}{100} =$ Rs 20736

5 7 eggs are sold for $4 \times \frac{140}{100}$a, *i e* 5 are sold for 4*r*

6 Let Rs x be the whole amt req^{d} Then Rs $\frac{40r}{100}$ is divided in the proportion of Rs 12500 Rs 8500
Now Rs 12500 + Rs 8500 = Rs 21000,

$$\frac{12500}{21000} \text{ of } \frac{40r}{100} = \frac{8500}{21000} \text{ of } \frac{40r}{100} + 300, \text{ and } r = \text{Rs } 3937\ 8\text{a}$$

7 Let $£x$ be rent, then $r - 25 - \frac{1\frac{1}{2}}{100}$ of $1150 = \frac{8}{100}$ of 1150,
whence $x = £134\frac{1}{4}$

8 Let x % of the whole pass Now 95 % of boys and 60 % of girls pass,

$$\frac{x}{100} \text{ of } 2500 = \frac{95}{100} \text{ of } 2000 + \frac{60}{100} \text{ of } 500, \text{ and } r = 88$$

9 Suppose A pays £100, he receives £105,
and D pays £$105\times\frac{130}{100}\times\frac{125}{100}$,
i e D pays £$157\frac{1}{2}$, A would gain $57\frac{1}{2}$ %

10 Suppose each article costs $100d$ Then C P is $300d$ and S P is $400d$
Profit $=100d$ on $300d$, or $33\frac{1}{3}d$ on $100d$, or $33\frac{1}{3}$ %

11 He actually sells at £21 − £1 6*s* 3*d*, or £19 13*s* 9*d*
Now £21 $=\frac{112}{100}$ of C P,
£19 13*s* 9*d*, or £$19\frac{11}{16}=\frac{112}{100}\times\frac{19\frac{11}{16}}{21}$ of C P $=\frac{105}{100}$ of C P,
profit $=5$ %

12 Let x % be gain req^{d} $\frac{1}{3}$ of Rs 36000 = Rs 12000,
$\frac{2}{5}$ of Rs 36000 = Rs 14400, rem^{r} = Rs 9600
$\frac{80}{100}$ of 12000 + $\frac{125}{100}$ of 14400 + $\frac{100+x}{100}$ of 9600 = $\frac{110}{100}$ of 36000
Cancelling we have $9600+18000+96(100+x)=39609$, and $x=25$

13 Let £x be cost of goods, then $\frac{120x}{100}=25$, and $x=20\frac{5}{6}$
gross profit £$(25-20\frac{5}{6})=£4\frac{1}{6}$ Now 10 % of £25 = £$2\frac{1}{2}$,
net profit = £$(4\frac{1}{6}-2\frac{1}{2})=£1\frac{2}{3}$

14 Let x lbs of first kind be mixed with y lbs of second kind
Expressing prices in annas we have
$$25(x+y)=\frac{125}{100}(14x+24y), \qquad 3x=2y, \text{ and } \frac{x}{y}=\frac{2}{3}$$

15 Let x gals of water be added to y gals of milk Expressing prices in pence, since $2d$ per pint $=16d$ per quart, we have
$$16(x+y)=\frac{140}{100} \text{ of } 13y, \qquad 80x=11y, \text{ and } \frac{x}{y}=\frac{11}{80}$$

16 Value of total wool produced in N Z $=\frac{18055}{60550}$ of £8593000
Value of wool exported from N Z = £4041000
Since amount is proportional to value, if x be req^{d} percentage,
$$\frac{x}{100}=\frac{4041000}{\frac{18055}{60550}\text{ of }8593000}$$
and
$$x=\frac{4041\times 60550}{8593\times 18055}\times 100=\frac{4041\times 60550}{8593\times 18055}\times 100$$
$$=\frac{10772}{16288}\times 100 \text{ (contracting)}=0\,661\times 100=66\text{ %}.$$

17 Let £x be total value of Canada's farm products,

then $\frac{90x}{100}=13\,1$ millions and $x=14\,6$ millions

Total imports to Britain $=\frac{100+44\frac{7}{9}}{100}\times 13\,1$ millions

$=\frac{544\frac{7}{9}}{100}\times 13\,1$ millions $=71\,7$ millions

18 $\frac{20}{100}$ of C P $=$£3, C P $=$£15 and S P $=\frac{120}{100}$ of £15 $=$£18

If £x be advertised price, then $\frac{75x}{100}=18$, and $x=$£24

19 Let x seers of water be added to 1 seer of milk,

$(x+1)\times 3\text{a}=\frac{160}{100}\times 1\times 2\frac{1}{2}\text{a}$, and $x=\frac{1}{3}$

20. Let x rupees be cost price,

then $\frac{105x}{100}-1=\frac{110}{100}$ of $\frac{95x}{100}$, and $x=$Rs 200

21. Rs 20 corresponds to an increase of 4 %,

$\frac{4}{100}$ of C P $=$Rs 20, and C P $=$Rs 500

22 Let x shillings be price per quarter at which he bought,

then $\frac{107\frac{1}{2}}{100}$ of $280x+\frac{110}{100}$ of $320x+\frac{112\frac{1}{2}}{100}$ of $100x-700x=$ total gain

This reduces to $65\frac{1}{2}x$ and $=$£100 19s 7d expressed in shillings

$65\frac{1}{2}x=2019\frac{7}{11}$, and $x=30\frac{5}{6}$, *i e* £1 10s 10d

23 Let x pence be C P per cwt, then $\frac{160}{100}x=\frac{95}{100}$ of 4×112

$x=266d=$£1 2s 2d

24. Let x lbs of first be mixed with y lbs of second

Then $94(x+y)=\frac{133\frac{1}{3}}{100}\{63x+78y\}$, *i e* $x=y$

25 Let Rs x be the price required, then $8x+22\times\frac{3x}{4}=\frac{140}{100}\times 3150$, and $x=$Rs 180

26 Water in first mixture $=(2\times 25+3\times 15)$ parts out of 500, *i e* 19 %

water in second mixture $=(\frac{19}{100}$ of $5+\frac{1}{4})$ parts out of $5\frac{1}{4}$, *i e* 23 %,

spirit in second mixture $=(100-23)$ %, *i e* 77 %

27 1 Kg or $\frac{9}{4}$ lbs cost $3\frac{1}{2}d$, 1 lb cost $\frac{14}{9}d$ Since it sold for 2d

profit is $\frac{4}{9}d$ on outlay of $\frac{14}{9}d$, giving 28 6% as profit he thought he made

Again 1 Kg or 1000 gm cost 3 5d, 1 gm cost 0 0035d, and 453 6 gms cost $(453\,6\times 0\,0035)d$, *i e* 1 5876d,

gain is $(2-1\,5876)d$ on outlay of 1 5876d, giving $\frac{41\,2400}{1\,5876}$ %, *i e* 26 %

28 Cost of materials and manufacture $= \frac{37}{100}$ of £3750

Remaining expenses $= £(387+940+136+200+\frac{1}{100}$ of $3750)$

$= £1700\ 5$

profit $= £(3750 - \frac{35}{100}$ of $3750 - 1700\ 5)$

$= £(\frac{6}{100}$ of $3750 - 1700\ 5) = £737$

In second part of question, gross sales $= \frac{140}{100}$ of £3750, or £5250,

cost of materials and manufacture $= \frac{37}{100}$ of £5250

Remaining expenses $= £(387+1880+136+200+\frac{1}{100}$ of $5250)$

$= £2655\ 5$,

profit $= £(5250 - \frac{37}{100}$ of $5250 - 2655\ 5)$

$= £(\frac{6}{100}$ of $5250 - 2655\ 5) = £757$,

increase in annual profit $= £(757 - 737) = £20$

EXAMPLES XVIII a Page 358

1-15 See Art 298, Ex 1 and 2

16

£
4 57
3
13 71
$4\frac{1}{2}$
54 84
6 855
61 695

$= £61\ 13s\ 11d$

17

£
51 27
3
153 81
$3\frac{1}{2}$
461 43
76 905
538 335

$= £538\ 6s\ 8d$

18

£
6 41
$3\frac{1}{4}$
19 23
1 6025
20 8325
$2\frac{1}{8}$
41 6650
2 6040
44 2690

$= £44\ 5s\ 5d$

19

£37 12
$2\frac{1}{2}$
74 24
18 56
92 80
$3\frac{3}{8}$
278 40
34 80 ($\frac{1}{8}$ of 278 4)
313 20

$= £313\ 4s$

20 Interest $= \dfrac{£761\ 11s\ 1d \times 6\frac{2}{3} \times 4\frac{1}{2}}{100}$

$= \dfrac{£761\ 11s\ 1d \times 3}{10}$

$= £228\ 9s\ 4d$

21 Interest $= £4\ 08121 \times \frac{1}{2} \times 4$

$= £8\ 162 = £8\ 3s\ 3d.$

22 Int = £1 567 | $25 \times \frac{7}{4} \times \frac{7}{49}$

62 69	
14 105	3
8 | 76 795	3
9 599	4
Prin 156 725	
Amt £166 324	

23 $I = \frac{£244\frac{1}{14} \times 3\frac{3}{4} \times 3}{100}$

$= £\frac{8\,7\,8\,7}{3\,5\,0} = £27\ 459$

$= £27\ 9s\ 2d$

Amt = £271 10*s* 10*d*

24 I = Rs 18 4290625 × $2\frac{2}{3} \times 2\frac{1}{4}$ = Rs 18 4290625 × 6 = Rs 110 9a 3p

Amt = Rs 1953 7a 9p

25 I = Rs 11 47171875 × $5\frac{1}{3} \times 2\frac{1}{4}$ = Rs 11 47171875 × 12

= Rs 137 660625 = Rs 137 10a 6p Amt = Rs 1284 13a 3p

26 I = £12 4 × $\frac{1}{4} \times 3\frac{1}{3}$ = £$\frac{31}{3}$ = £10 6*s* 8*d*

27 I = Rs 5 484 × $\frac{1}{2} \times 4\frac{1}{2}$ = Rs 5 484 × $\frac{9}{4}$ = Rs 12 34

28 I = Rs 4 375 × $\frac{2}{3} \times 4$ = Rs $11\frac{2}{3}$ = Rs 11 10a 8p

Amt = Rs 449 2a 8p

29 I = Rs 62 80 × $2\frac{1}{4} \times \frac{1}{20}$ = Rs 70 65 Amt = 6350 Rs 65 cents

EXAMPLES XVIII b Page 361

1 146 days = $\frac{2}{5}$ year,

I = Rs 7 50 × $\frac{2}{5} \times 3\frac{3}{4}$ = Rs 11 25, and Amt = Rs 761 4 a

2 292 days = $\frac{4}{5}$ year,

I = £18 35 × $\frac{4}{5} \times 1\frac{1}{4}$ = £18 35, and Amt = £1853 7*s*

3 219 days = $\frac{3}{5}$ year,

I = Rs 16 875 × $\frac{3}{5} \times 6$ = Rs 60 75, and Amt = Rs 1748 4a

4 73 days = $\frac{1}{5}$ year, I = £2 $52\frac{1}{140} \times \frac{1}{5} \times 3$ = £1 5125 = £1 10*s* 3*d*,

and Amt = £253 11*s* 11*d*

5 $I = \frac{£16\ 06 \times 400 \times 11}{365 \times 2}$ = £96 8, Amt = £1702 16*s*

6 $I = \frac{£820\ 4s\ 2d \times 2\frac{2}{5} \times 2\frac{1}{2}}{100} = \frac{£4921\ 5s}{100}$ = £49 4*s* 3*d*,

Amt = £869 8*s* 5*d*

7 Time = 146 days = $\frac{2}{5}$ year,

$I = \frac{\text{Rs } 4\,265 \times 2 \times 3}{5}$ = Rs 5 118, and Amt = Rs 431 10a

8 Time = 196 days,

$$I = \frac{\text{Rs } 2\,19 \times 196 \times 10}{365 \times 3} = \text{Rs } 3\,92, \text{ and Amt} = \text{Rs } 222\ 14\text{a } 9\text{p}$$

9 Time = 219 days = $\frac{3}{5}$ year,

$$I = \frac{\text{Rs } 3\,7575 \times 3 \times 35}{5 \times 8} = \frac{\text{Rs } 394\,5375}{40}$$

$$= \text{Rs } 9\,8634375, \text{ and Amt} = \text{Rs } 385\ 9\text{a } 9\text{p}$$

10 Time = 146 days = $\frac{2}{5}$ year,

$$I = \frac{£7\,808 \times 2 \times 55}{5 \times 16} = £10\,736, \text{ and Amt} = £791\ 10s\ 9d$$

11 $I = \text{Rs } 3\,16 \times \frac{33}{365} \times 5 = \frac{\text{Rs } 3\,16 \times 33}{73} = \text{Rs } 1\,428 = \text{Re } 1\ 6\text{a } 9\text{p}$

12 $I = \text{Rs } 5\,47 \times \frac{54}{365} \times \frac{7}{5} = \text{Rs } 5\,47 \times \frac{378}{1825} = \text{Rs } 2\,0231 = \text{Rs } 2\ 0\text{a } 3\text{p}$

13 $I = \text{Rs } 70 \times \frac{86}{365} \times 4 = \frac{\text{Rs } 14 \times 344}{73} = \text{Rs } 65\,9726 = \text{Rs } 65\ 15\text{a } 6\text{p}$

14 $I = \text{Rs } 7\,08 \times \frac{113}{365} \times \frac{7}{2} = \frac{\text{Rs } 560\,028}{73} = \text{Rs } 7\,6716 = \text{Rs } 7\ 10\text{a } 9\text{p}$

15 $I = \text{Rs } 965\,90625 \times \frac{98}{365} \times \frac{4}{100} = \text{Rs } 9\,6590625 \times \frac{784}{73} = \frac{\text{Rs } 757\,2705}{73}$

$= \text{Rs } 10\,3735 = \text{Rs } 10\ 6\text{a}$

16 Time = 65 days, $I = £4\,13 \times \frac{65}{365} \times 4 = \frac{£214\,76}{73} = £2\,9419$,

and Amt = £415 18*s* 10*d*

17 Time = 80 days, $I = £5\,10 \times \frac{80}{365} \times 3 = \frac{£244\,8}{73} = £3\,3534$,

and Amt = £513 7*s* 1*d*

18 Time = 101 days, $I = £24\,50 \times \frac{101}{365} \times \frac{7}{2} = \frac{£1732\,15}{73} = £23\,7281$,

and Amt = £2473 14*s* 7*d*

19 Time = 212 days, $I = £13\,6875 \times \frac{212}{365} \times \frac{19}{4} = \frac{£2\,7375 \times 1007}{73}$

$= \frac{£2756\,6625}{73} = £37\,7624$, and Amt = £1406 10*s* 3*d*

20 Time = 108 days,

$$I = £402\,5375 \times \frac{108}{365} \times \frac{4\frac{1}{8}}{100} = £4\,025375 \times \frac{108}{365} \times \frac{33}{8}$$

$$= £4\,025375 \times \frac{891}{73} = \frac{£358\,6609}{73} = £4\,9131,$$

and Amt = £407 9*s*

21 Time = 146 days = $\frac{2}{5}$ year, $I = \text{Rs } 12\,50 \times \frac{2}{5} \times \frac{15}{4} = \text{Rs } 18\,75$,
and Amt = Rs 1268 12 a

22 From July 5 to Nov 18 is 136 days,

$$I = £5 \times \frac{136}{365} \times \frac{5}{2} = \frac{£340}{73} = £4\,6575 \ ,$$

on Nov 18 he receives £204 13*s* 2*d*

From Nov 18 to Feb 20 is 94 days,

$$I = £3 \times \frac{94}{365} \times \frac{5}{2} = \frac{£141}{73} = £1\,9315 \ ,$$

on Feb 20 he receives £301 18*s* 8*d*

23 From May 1 to Dec 31 is 244 days, Aug 1 to Dec 31, 152 days,

$$I = \text{Rs } 3\,50 \times \frac{244}{365} \times \frac{15}{4} + \text{Rs } 2\,70 \times \frac{152}{365} \times \frac{15}{4}$$

$$= \left(\frac{\text{Rs } 170\,8}{73} + \frac{\text{Rs } 82\,08}{73}\right) \times \frac{15}{4} = \frac{\text{Rs } 252\,88}{73} \times \frac{15}{4}$$

$$= \frac{\text{Rs } 948\,3}{73} = \text{Rs } 12\,9904$$

I owe Rs 632 15 a 9 p

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[*In these examples the symbols* P, I, r, n *are used as in Art* 298]

1–8 See Art 302, Ex 1 9–12 See Art 302, Ex 2

13 $P + \frac{P \times \frac{1}{4} \times 2\frac{1}{4}}{100} = 5430\frac{3}{8}$, or $P = \frac{43443}{8} \times \frac{1600}{1609} = £5400$

14 $3\frac{1}{2} \times 2\frac{1}{2} = 8\,75$, $P = \frac{\text{given Amt}}{\text{Amt of £1}} = \frac{527\,4375}{1\,0875} = £485$

15 $\frac{2}{5} \times 6 = 2\,4$, $P = \frac{\text{given Amt}}{\text{Amt of £1}} = \frac{204\,8}{1\,024} = £200$

16 $P + P \times \frac{2\frac{1}{2} \times 3}{100} = 254\frac{14}{40}$, $P = 254\frac{7}{120} \times \frac{200}{215} = £236\frac{1}{3}$

17 Int on £P = (Int on £1) × P, $P = \frac{152}{0\,1125} = \text{Rs } 1351\ 1\,a\ 9$

18 As in 17, $P = \frac{24\,9}{0\,105} = £237$ (to nearest £)

19 As in 17, $P=\frac{17\frac{1}{10}}{\frac{8}{12}\times\frac{5}{2}\over 100}=\frac{287\times100\times3}{16\times5}=£1076$ (to nearest £)

20 $P+P\times\frac{1\frac{3}{4}\times3}{100}=327\ 117$, $P=327\ 117\times\frac{400}{421}=£310.\ 16s$

21 $P+P\times\frac{5\times2\frac{1}{2}}{100}=2000$, $P=2000\times\frac{200}{225}=£1778$ (to nearest £)

22-26 See Art 303, Ex 1

27-30 Find interest by subtracting Principal from Amount, then see Art 303, Ex 1

31 If n be req^{d} fraction of a year,

$$n=\frac{\text{given Int}}{\text{Int for 1 year}}=\frac{3\frac{1}{2}}{250\times\frac{5}{100}}=0\ 28\text{ yr}=103\text{ days}$$

32 As in 31, $n=\frac{23\ 7}{1572\ 85\times\frac{5\frac{1}{2}}{100}}\text{ yrs}=\frac{4740}{1572\ 85\times11}\times365\text{ days}$

$$=\frac{4740\times73}{3474\ 27}=\frac{346\ 02}{3\ 4727}=100\text{ days}$$

33 As in 31, $n=\frac{4\ 675}{382\times\frac{4}{100}}\text{ yrs}=\frac{467\ 5}{1528}\times365\text{ days}$

$$=\frac{170\ 63}{1\ 528}\text{ days}=112\text{ days}$$

34-37 See Art 304 38-40 Find interest and see Art 304

41 $r=\frac{\text{given Int}}{\text{Int at 1 per cent}}=\frac{12\frac{3}{10}}{650\times\frac{5}{12}\times\frac{1}{100}}=4\frac{1}{2}$

42 As in No 41, $r=\frac{11\frac{2}{3}}{437\frac{1}{2}\times\frac{2}{3}\times\frac{1}{100}}=4$

43 If Principal is £100, then Interest is £200, and, as in 41,

$$r=\frac{200}{100\times25\times\frac{1}{100}}=8$$

44 As in 41, $r=\frac{50}{564\times2\frac{1}{2}\times\frac{1}{100}}=\frac{500}{141}=3\ 55$

45 As in 41, $r=\dfrac{100}{3550\times\frac{5}{12}\times\frac{1}{100}}=\dfrac{480}{71}=6\,76$

46 $P+P\times\dfrac{4\frac{1}{2}\times5}{100}=2519\,9$ $\qquad P=\dfrac{200}{245}$ of $2519\,9=£2057$

47 (i) Annual interest is $£\frac{1}{8}\times52$, *i e* £6 5

$$P\times\frac{2\frac{3}{4}\times1}{100}=6\,5,\ \text{or}\ P=650\times\tfrac{4}{11}=£236\ 7s$$

(ii) Annual interest $=£\frac{365}{40}$

$$P\times\frac{2\frac{3}{4}\times1}{100}=\frac{365}{240},\ \text{or}\ P=\frac{3650}{66}=£55\ 6s$$

48 As in Art 303, Ex 1, $n=\dfrac{1}{30\,5\times\frac{5}{100}}$ yrs

$$=\frac{100}{30\,5\times5}\times365\text{ days}=240\text{ days}$$

49 As in Art 303, Ex 1, $n=\dfrac{12\,904}{1000\times\frac{3}{100}}$ yrs $=0\,43$ yrs $=157$ days

This gives Jan 9th

50. From Jan 1 to Aug 8$=219$ days$=\frac{3}{5}$ yr From Art 303,

$$P=\frac{36}{\frac{3}{5}\times\frac{4}{100}}=£1500$$

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1 Disc $=$Rs $20\,20\times\frac{1}{4}\times4=$Rs $20\ 3$a 3p

2 Disc $=$Rs $63\,31\times\frac{7}{12}\times\frac{5}{12}=\dfrac{\text{Rs }4431\,7}{48}=$Rs $92\ 5$a 3p

3 Disc $=$Rs $6\,94203125\times\frac{11}{12}\times\frac{8}{12}=$Rs $0\,8677\times33=$Rs $28\,634$
$=$Rs $28\ 10$a 3p

4 Disc $=$Rs $5\,31375\times\frac{2}{5}\times3=$Rs $6\ 6$a (146 days$=\frac{2}{5}$ year)

5 Disc $=$Rs $3\,67921875\times\frac{3}{5}\times\frac{5}{12}=$Rs $5\,518$ $=$Rs $5\ 8$a 3p
(219 days$=\frac{3}{5}$ yr)

6 Disc $=$Rs $8\,90\times\frac{10}{12}\times7=$Rs $51\,9166$ $=$Rs $51\ 14$a 9p

7 Disc $=$Rs 7 2990625 $\times \frac{2}{3} \times \frac{7}{12}$ $=$Rs 12 165 $=$Rs 12 2a 9p

8 Disc $=$Rs 5 31265625 $\times \frac{11}{12} \times 3$ $=$Rs 14 609 $=$Rs 14 9a 9p

9 Disc $=$£7 62 $\times \frac{176}{365} \times 4 = \frac{£1072\ 896}{73} =$£14 697 $=$£14 13s 11d

10 Disc $\times$£2 0535 $\times \frac{87}{365} \times 3 = \frac{£0\ 4107 \times 261}{73} = \frac{£107\ 1927}{73}$
$=$£1 468 $=$£1 9s 4d

11 $10\% = \frac{1}{10}$ Neglecting 3s 8d for percentage purposes, we have sum req^d $=$£25 13s 8d $-\frac{1}{10}$ of £25 10s $=$£23 2s 8d

12 As in 11, sum req^d $=$£14 3s 2d $-\frac{1}{10}$ of £14 $=$£13 9s 2d

13 As in 11, sum req^d $=$£41 11s $-\frac{1}{10}$ of £41 10s $=$£39 9s 6d

14 As in 11, sum req^d $=$£38 4s 8d $-\frac{1}{10}$ of £38 $=$£37 5s 8d

15 $5\% = \frac{1}{20}$ If Rs x be amt req^d, $\frac{19x}{20} =$26 359 and $x =$Rs 27 75

16 $10\% = \frac{1}{10}$ If £x be amt req^d, $\frac{9x}{10} =$16 65 and $x =$£18 5

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1 Time $=$73 days $= \frac{1}{5}$ year, Disc $=$Rs 6 03 $\times \frac{1}{5} \times \frac{5}{2} =$Rs 3 0a 3p

2 Time $=$219 days $= \frac{3}{5}$ year, Disc $=$Rs 9 5275 $\times \frac{1}{5} \times 5$
$=$Rs 28 9a 3p

3 Time $=$99 days, Disc $=$Rs 3 81 $\times \frac{99}{365} \times 4 = \frac{\text{Rs } 0\ 762 \times 396}{73}$
$= \frac{\text{Rs } 301\ 752}{73} =$Rs 4 1335 $=$Rs 4 2a 3p

4 Time $=$83 days, Disc $=$Rs 4 86 $\times \frac{83}{365} \times 3 = \frac{\text{Rs } 0\ 972 \times 249}{73}$
$= \frac{\text{Rs } 242\ 028}{73} =$Rs 3 315 $=$Rs 3 5a

5 Time $=$61 days, Disc $=$Rs 27 6325 $\times \frac{61}{365} \times \frac{5}{2} = \frac{\text{Rs } 1685\ 5825}{146}$
$=$Rs 11 545 $=$Rs 11 8a 9p

6 Time $=154$ days, Disc $=\text{Rs } 3\,17 \times \frac{154}{365} \times \frac{5}{2} = \frac{\text{Rs } 244\,09}{73}$

$=\text{Rs } 3\,3437 = \text{Rs } 3\ 5a\ 6p$, Cash req^d $=\text{Rs } 317 - \text{Rs } 3\ 5a\ 6p$

7 Time $=292$ days $=\frac{4}{5}$ yea, Disc. $=£19\,342 \times \frac{4}{5} \times \frac{2}{4} = £34\,8156$

$=£34\ 16s\ 4d$, Cash req^d $=£1934\ 4s - £34\ 16s\ 4d$

8 Time $=83$ days, Disc $=£36\,7555 \times \frac{83}{365} \times \frac{7}{2} = \frac{£7\,3511 \times 581}{146}$

$=\frac{£4270\,9891}{146} = £29\,253 \quad = £29\ 5s\ 1d$,

Cash req^d $=£3675\ 11s - £29\ 5s\ 1d$

9 Time $=121$ days, Disc $=£7\,45917 \times \frac{121}{365} \times \frac{7}{2} = \frac{£0\,745917 \times 847}{73}$

$=\frac{£631\,7917}{73} = £8\,655 = £8\ 13s\ 1d$,

Cash req^d $=£745\ 18s\ 4d - £8\ 13s\ 1d$

10 Time $=11$ days, Disc $=£10\,31642 \times \frac{4}{365} \times 6$

$=\frac{£1\,031642 \times 492}{73} = \frac{£507\,5689}{73} = £6\,953 = £6\ 19s\ 1d$,

Cash req^d $=£1031\ 12s\ 10d - £6\ 19s\ 1d$

11 From Art 298, $I = \frac{P \times r \times n}{100}$, where I is in this case the discount,

$$r = \frac{100 \times I}{P \times n} = \frac{100 \times 5\,05}{505 \times \frac{1}{4}} = 4\,\%$$

12 As in No 11, $r = \frac{100 \times 2\,25}{270 \times \frac{1}{3}} = 2\frac{1}{2}\,\%$

13 From formula in No 11, $r = \frac{100 \times I}{P \times r} = \frac{100 \times 6\frac{9}{10}}{175 \times 5} = \frac{3}{4}$ yr $= 9$ months

14 As in No 13, $n = \frac{100 \times 12\,8}{960 \times 4} = \frac{1}{3}$ yr $= 4$ months

15 Off a bill of £100 he takes £4, he charges £4 for the loan of £96 for 10 months, i e £4 $\times \frac{12}{10}$ for the loan of £96 for 1 year,

hence rate req^d $= 5\,\%$

16 As in 15, he charges £2½ for the loan of £97½ for 3 months, i e £10 for the loan of £97½ for 12 months,

hence rate req^d $= 10\,26\,\%$

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N B In this set of examples,
A_n denotes Amount in n years,
P_n „ the Principal *at the beginning of the* n^{th} *year*,
I_n „ the n^{th} year's interest

1
	Rs
P_1	200
I_1	10
P_2	210
I_2	10 5
A_2	220 5

2
	Rs
P_1	2500
I_1	100
P_2	2600
I_2	104
A_2	2704

3
	Rs
P_1	3750
I_1	112 5
P_2	3862 5
I_2	115 875
A_2	3978 375

4
	Rs
P_1	3500
I_1	175
P_2	3675
I_2	183 75
P_3	3858 75
I_3	192 9375
A_3	4051 6875

5
	Rs
P_1	750
I_1	15
P_2	765
I_2	15 3
P_3	780 3
I_3	15 606
P_4	795 906
I_4	15 918
A_4	811 824

6
	Rs	
P_1	3300	
I_1	165	
P_2	3465	
I_2	173 25	
P_3	3638 25	
I_3	181 912	5
P_4	3820 162	5
I_4	191 008	12
A_4	4011 171	

7
	£
P_1	225
I_1	9
P_2	234
I_2	9 36
P_3	243 36
P_1	225
CI	18 36

8
	£	
P_1	425	
I_1	17	
P_2	442	
I_2	17 68	
P_3	459 68	
I_3	18 387	2
P_4	478 067	2
P_1	425	
CI	53 067	

9
	£	
P_1	725	
I_1	21 75	
P_2	746 75	
I_2	22 402	5
P_3	769 152	5
I_3	23 074	57
P_4	792 227	07
I_4	23 766	81
P_5	815 993	8
P_1	725	
CI	90 994	

10
	£	
P_1	3546	
I_1	177 3	
P_2	3723 3	
I_2	186 165	
P_3	3909 465	
I_3	195 473	25
P_4	4104 938	25
P_1	3546	
CI	558 938	

11
	£	
P_1	345 75	
I_1	13 83	
P_2	359 58	
I_2	14 383	2
A_2	373 963	

12
	£	
P_1	472 9	
I_1	14 187	
P_2	487 087	
I_2	14 612	61
P_3	501 699	61
I_3	15 050	97
A_3	516 751	

13

	£	
P_1	1243 713	
I_1	62 185	65
P_2	1305 898	65
I_2	65 294	93
A_2	1371 194	

14.

	Rs	
P_1	473 85	
I_1	18 954	0
P_2	492 801	0
I_2	19 712	16
P_3	512 516	16
I_3	20 500	64
A_3	533 017	

15

	Rs	
P_1	5000	
I_1	125	
P_2	5125	
I_2	128 125	
P_3	5253 125	
I_3	131 328	1
A_3	5384 453	

16

	Rs	
P_1	4500	
I_1 $\frac{4}{100}$	180	
I_1 $\frac{1}{400}$	11 25	
P_2	4691 25	
I_2 $\frac{4}{100}$	187 65	
I_2 $\frac{1}{400}$	11 728	12
A_2	1890 628	

17

	Rs	
P_1	4750	
I_1 $\frac{3}{100}$	142 5	
I_1 $\frac{1}{200}$	23 75	
P_2	4916 25	
I_2 $\frac{3}{100}$	147 487	5
I_2 $\frac{1}{200}$	24 581	25
P_3	5088 318	75
I_3 $\frac{3}{100}$	152 649	56
I_3 $\frac{1}{200}$	25 441	59
A_3	5266 410	

18

	Rs	
P_1	6750	
I_1 $\frac{4}{100}$	270	
I_1 $\frac{1}{200}$	33 75	
P_2	7053 75	
I_2 $\frac{4}{100}$	282 15	
I_2 $\frac{1}{200}$	35 268	75
P_3	7371 168	75
I_3 $\frac{4}{100}$	294 846	75
I_3 $\frac{1}{200}$	36 855	81
A_3	7702 871	

19

	£	
P_1	5016 575	
I_1 $\frac{4}{100}$	200 663	
I_1 $\frac{1}{200}$	25 082	87
P_2	5242 320	87
I_2 $\frac{4}{100}$	209 692	83
I_2 $\frac{1}{200}$	26 211	60
A_2	5478 225	

20

	£	
P_1	1601 233	
I_1 $\frac{3}{100}$	48 036	99
I_1 $\frac{1}{400}$	4 003	08
P_2	1653 273	07
I_2 $\frac{3}{100}$	49 598	19
I_2 $\frac{1}{400}$	4 133	18
P_3	1707 004	14
I_3 $\frac{3}{100}$	51 210	13
I_3 $\frac{1}{400}$	4 267	51
A_3	1762 482	

21

	£
P_1	2000
I_1	100
P_2	2100
I_2	105
$P_{2\frac{1}{2}}$	2205
$I_{2\frac{1}{2}}$	55 125
$A_{2\frac{1}{2}}$	2260 125
P_1	2000
C I	260 125

22

	£	
P_1	5620	
I_1	224 8	
P_2	5844 8	
I_2	233 792	
$P_{2\frac{1}{2}}$	6078 592	
$I_{2\frac{1}{2}}$	121 571	8
$A_{2\frac{1}{2}}$	6200 163	8
P_1	5620	
CI	580 164	

23

	£	
P_1	3600	
I_1	90	
P_2	3690	
I_2	92 25	
P_3	3782 25	
I_3	94 556	25
$P_{3\frac{1}{2}}$	3876 806	25
$I_{3\frac{1}{2}}$	48 460	1
$A_{3\frac{1}{2}}$	3925 266	3
P_1	3600	
CI	325 266	

24

		£	
P_1		8457 725	
I_1	$\frac{1}{100}$	84 577	25
	$\frac{1}{400}$	21 144	31
P_2		8563 446	56
I_2	$\frac{1}{100}$	85 634	46
	$\frac{1}{400}$	21 408	61
$P_{2\frac{1}{2}}$		8670 489	63
$I_{2\frac{1}{2}}$	$\frac{1}{100}$	21 676	22
	$\frac{1}{1600}$	5 419	05
$A_{2\frac{1}{2}}$		8697 584	9
P_1		8457 725	
CI		239 860	

25

		Rs	
P_1		504 687	5
I_1	$\frac{4}{100}$	20 187	5
	$\frac{1}{400}$	2 523	44
P_2		527 398	44
I_2	$\frac{4}{100}$	21 095	94
	$\frac{1}{400}$	2 636	99
$P_{2\frac{1}{2}}$		551 131	37
$I_{2\frac{1}{2}}$	$\frac{1}{100}$	5 511	31
	$\frac{1}{400}$	2 755	66
$A_{2\frac{1}{2}}$		559 398	34
P_1		504 687	5
CI		54 711	

NB In Nos 26–31, P_1, $P_{1\frac{1}{2}}$, P_2, $P_{2\frac{1}{2}}$, etc, denote the Principals *for successive half years*

26

		£	
1st half yr's	P_1 I $(\frac{2}{100})$	320 75	
		6 415	
2nd half-yr's	$P_{1\frac{1}{2}}$ I $(\frac{2}{100})$	327 165	
		6 543	3
3rd half yr's	P_2 I $(\frac{2}{100})$	333 708	3
		6 674	16
	$A_{1\frac{1}{2}}$	340 382	

27

		£	
1st half-yr's	P_1 I $(\frac{1}{10})$	520 8	
		13 02	
2nd half-yr's	$P_{1\frac{1}{2}}$ I $(\frac{1}{10})$	533 82	
		13 345	5
3rd half-yr's	P_2 I $(\frac{1}{10})$	547 165	5
		13 679	14
4th half-yr's	$P_{2\frac{1}{2}}$ I $(\frac{1}{10})$	560 844	64
		14 021	11
	A_2	574 866	

28

		Rs
	P_1	16000
1st half-yr's I	$\frac{2}{100}$	320
	$\frac{1}{400}$	40
	$P_{1\frac{1}{2}}$	16360
2nd half-yr's I	$\frac{2}{100}$	327 2
	$\frac{1}{400}$	40 9
	P_2	16728 1
3rd half-yr's I	$\frac{2}{100}$	334 562
	$\frac{1}{400}$	41 820 2
	$A_{1\frac{1}{2}}$	17101 182

29

		Rs	
	P_1	100000	
1st half-yr's I	$\frac{1}{100}$	1000	
	$\frac{1}{400}$	250	
	$P_{1\frac{1}{2}}$	101250	
2nd half-yr's I	$\frac{1}{100}$	1012 5	
	$\frac{1}{400}$	253 125	
	P_2	102515 625	
3rd half-yr's I	$\frac{1}{100}$	1025 156	25
	$\frac{1}{400}$	256 289	06
	$P_{2\frac{1}{2}}$	103797 070	31
4th half-yr's I	$\frac{1}{100}$	1037 970	70
	$\frac{1}{400}$	259 492	67
	P_3	105094 533	68
5th half-yr's I	$\frac{1}{100}$	1050 945	33
	$\frac{1}{400}$	262 736	33
	$A_{2\frac{1}{2}}$	106108 215	

30

		Rs	
	P_1	250	
1st quarter's I	$\frac{1}{100}$	2 5	
	$\frac{1}{400}$	0 625	
	$P_{1\frac{1}{4}}$	253 125	
2nd quarter's I	$\frac{1}{100}$	2 531	25
	$\frac{1}{400}$	0 632	81
	$P_{1\frac{1}{2}}$	256 289	06
3rd quarter's I	$\frac{1}{100}$	2 562	89
	$\frac{1}{400}$	0 640	72
	$P_{1\frac{3}{4}}$	259 492	67
4th quarter's I	$\frac{1}{100}$	2 594	92
	$\frac{1}{400}$	0 648	73
	A_1	262 736	

31 (i)

		£
	P_1	100
1st half-yr's I		5
	$P_{1\frac{1}{2}}$	105
2nd half-yr's I		5 25
	P_2	110 25

effective annual rate
=10·250 %

31 (ii)

		£	
	P_1	100	
1st quarter's I	$\frac{1}{100}$	1	
	$\frac{1}{400}$	0 25	
	$P_{1\frac{1}{4}}$	101 25	
2nd quarter's I	$\frac{1}{100}$	1 012	5
	$\frac{1}{400}$	0 253	12
	$P_{1\frac{1}{2}}$	102 515	62
3rd quarter's I	$\frac{1}{100}$	1 025	15
	$\frac{1}{400}$	0 256	29
	$P_{1\frac{3}{4}}$	103 797	06
4th quarter's I	$\frac{1}{100}$	1 037	97
	$\frac{1}{400}$	0 259	49
	A_1	105 095	

effective annual rate
=5·095 %

31 (iii)

		£	
	P_1	100	
1st quarter's I	$\frac{1}{200}$	0 5	
	$\frac{1}{800}$	0 125	
	$P_{1\frac{1}{4}}$	100 625	
2nd quarter's I	$\frac{1}{200}$	0 503	12
	$\frac{1}{800}$	0 125	78
	$P_{1\frac{1}{2}}$	101 253	90
3rd quarter's I	$\frac{1}{200}$	0 506	27
	$\frac{1}{800}$	0 126	57
	$P_{1\frac{3}{4}}$	101 886	74
4th quarter's I	$\frac{1}{200}$	0 509	43
	$\frac{1}{800}$	0 127	36
	A_1	102 524	

effective annual rate
=2·524 %

EXAMPLES XVIII g Page 376

N B A_n, P_n, I_n have the same meanings as in Ex XVIII f

1 $A_2 = \text{Rs } 387 \times (1\cdot03)^2 = \text{Rs } 387 \times 1\cdot0609 = \text{Rs } 410\cdot5683$

2 $A_3 = \text{Rs } 873\cdot5 \times (1\cdot04)^3$
$= \text{Rs } 873\cdot5 \times 1\cdot124864$
$= \text{Rs } 982\cdot569$

873·5	
1·124864	
873·5	
87·35	
17·470	
3·494	0
·698	8
·052	4
·003	5
982·568	7

3 $A_3 = £953\cdot775 \times (1\cdot05)^3$
$= £953\cdot775 \times 1\cdot157625$
$= £1104\cdot113$

953·775	
1·157625	
953·775	
95·377	5
47·688	8
6·676	4
·572	3
·018	1
·004	8
1104·112	9

4 $P = \dfrac{\text{given Amt}}{\text{Amt of £1}} = \dfrac{£296}{(1\cdot03)^2} = \dfrac{£296}{1\cdot0609} = £279$

5 $P = \dfrac{\text{given Amt}}{\text{Amt of £1}} = \dfrac{£340\cdot95}{(1\cdot03)^3} = \dfrac{£340\cdot95}{1\cdot092727} = £312$

6 $P = \dfrac{\text{given Amt}}{\text{Amt of £1}} = \dfrac{£3244\cdot9}{(1\cdot04)^2} = \dfrac{£3244\cdot9}{1\cdot0816} = £3000$

7 $P = \dfrac{\text{given Amt}}{\text{Amt of £1}} = \dfrac{£5343\cdot112}{(1\cdot04)^3} = \dfrac{£5343\cdot112}{1\cdot124864} = £4750$

8 $P = \dfrac{\text{given Amt}}{\text{Amt of £1}} = \dfrac{£3820\cdot162}{(1\cdot05)^3} = \dfrac{£3820\cdot162}{1\cdot157625} = £3300$

9 $P = \dfrac{\text{given Amt}}{\text{Amt of £1}} = \dfrac{£275\cdot95}{(1\cdot025)^4} = \dfrac{£275\cdot95}{(1\cdot0506)^2} = \dfrac{£275\cdot95}{1\cdot1038} = £250$

10 $P=\frac{\text{given Amt}}{\text{Amt of Re 1}}=\frac{\text{Rs } 300}{(1\cdot01)^3}$

$=\frac{\text{Rs } 300}{1\ 124864}$

$=\text{Rs } 266\ 699$

1 124864	266 699
	300
	750272
	75354
	7862
	1113
	101

11 $P=\frac{\text{given Amt}}{\text{Amt of Re 1}}=\frac{\text{Rs } 850}{(1\cdot05)^4}=\frac{\text{Rs } 850}{1\ 1025}=\text{Rs } 770\ 975$

12 $P=\frac{\text{given Amt}}{\text{Amt of Re 1}}=\frac{\text{Rs } 2000}{(1\cdot03)^5}$

$=\frac{\text{Rs } 2000}{1\cdot092727}$

$=\text{Rs } 1830\ 283$

1 092727	1830 283
	2000
	907273
	33091
	3096
	911
	37
	5

13 $P=\frac{\text{given Amt}}{\text{Amt of Re 1}}=\frac{\text{Rs } 6027\ 875}{(1\ 0375)^4}=\frac{\text{Rs } 6027\ 875}{1\ 07640625}=\text{Rs } 5600$

14. $P=\frac{\text{given Amt}}{\text{Amt of Re 1}}=\frac{\text{Rs } 3925\ 265625}{(1\cdot025)^3\times1\ 0125}=\frac{\text{Rs } 3925\ 265625}{1\ 076890625\times1\ 0125}$

$=\frac{\text{Rs } 3925\ 266}{1\cdot090351758}=\text{Rs } 3600$

15 $A=\text{Rs } 250\times1\ 04\times1\ 08=\text{Rs } 280\ 8$

16 From Art 313, the Amt in 2 years $=P\times(1\ 05)^2$,

hence Amt in $2\frac{1}{2}$ yrs $=P\times(1\ 05)^2\times1\ 025$

For second part of question

$P=\frac{\text{given Amt}}{\text{Amt of Re 1}}$

$=\frac{\text{Rs } 22050}{(1\cdot05)^2\times(1\cdot025)}$

$=\frac{\text{Rs } 22050}{1\ 1025\times1\cdot025}$

$=\frac{\text{Rs } 22050}{1\ 13006}$

$=\text{Rs } 19512$

1 13006	19512
	220500
	107494
	5789
	1309
	246
	3

17 $P=\frac{\text{given Amt}}{\text{Amt of Re 1}}=\frac{\text{Rs } 2811\ 90625}{1\ 03\times1\ 04\times1\ 05}=\frac{\text{Rs } 2811\ 90625}{1\ 12476}=\text{Rs } 2500$

18 $A_2 = P \times (1\ 035)^2 = 1\ 07123$ (approx)

19 $CI = A_3 - P = P \times (1\ 05)^3 - P = P\{(1\ 05)^3 - 1\} = P \times 0\ 15763$ (approx),
we have £50 = P × 0 15763, and P = £50 − 0 15763 = £317

20 Popⁿ for 1891 $= \frac{37632}{1\ 12} = 33600$, popⁿ for 1881 $= \frac{33600}{1\ 12} = 30000$

21 Reqᵈ population = 347865 × 1 02 × 1 025 × 1 03 to nearest hundred
= 3478 65 × 1 0769 to nearest unit
= 3746
Hence answer = 374600

22 CI on £1 = £(1 04)³ − £1 = £0 124864
SI on £1 = 0 04 × 3 = £0 12, diff for £1 = £0 004864
Hence diff for £3125 = £3125 × 0 004864 = £15 2

23 CI on £1 = £(1 04)⁴ − £1 = £0 169859
SI on £1 = 0 04 × 4 = £0 16,
diff for £1 = £0 009859, and diff for £1000 = £9 859

24 CI on £1 = £(1 05)³ − £1 = £0 157625
SI on £1 = £0 05 × 3 = £0 15, diff for £1 = £0 007625
Hence diff for £2400 = £2400 × 0 007625 = £18 3

25 CI on £1 = £(1 0375)² − £1 = £0 07640625
SI on £1 = £ 0375 × 2 = £0 075, diff for £1 = £0 00140625
Hence diff for £2960 = £2960 × 0 00140625 = £4 163

26 CI on £1 = £(1 02)⁴ − £1 = £0 08243216
SI on £1 = 0 02 × 4 = £0 08, diff for £1 = 0 00243216
Hence diff for £7545 5 = £7545 5 × 0 00243216
= £7 5455 × 2 43216 = £18 352

27 From Note, Ex 2, p 376,
$$P = \frac{\text{diff on £P}}{\text{diff on £1}} = \frac{£0\ 6}{0\ 0025} = £240$$

28 As in 27, $P = \frac{£15\ 2}{0\ 04864} = £3125$ 29 As in 27, $P = \frac{Rs\ 3\ 375}{0\ 0009} = Rs\ 3750$

30 As in 27, $P = \frac{Rs\ 38\ 125}{0\ 007625} = Rs\ 5000$

31 The CI is reckoned on Rs (26333 3125 − 13000),
i e Rs 13333 3125 Amt = Rs 13333 3125 × (1 035)²
= Rs 13333 3125 × 1 071225 = Rs 14282 977

32

	Rs
P_0	4000
I_0	200
P_1	4200
I_1	210
P_2	4410
I_2	220 5
P_3	4630 5
I_3	231 525
P_4	4862 025

total savings $=$

	Rs
P_0	1000
P_1	4200
P_2	4410
P_3	4630 5
P_4	4862 025
	22102 525

i e Rs 22103

33

	Rs
P_1	200
I_1	10
A_1	210
Subtract	50
P_2	160
I_2	8
A_2	168
Subtract	50
P_3	118
I_3	5 9
A_3	123 9
Subtract	50
	73·9
I_4	3 695
A_4	77 595
Subtract	50
	27 595

i e Rs 27 9a 6p

34 Its value at the end of each year $= \left(1 - \frac{12\frac{1}{2}}{100}\right)$ of its value at the beginning of the year

This fraction reduces to $\frac{7}{8}$

Value req^{d} $=$ Rs $24000 \times (\frac{7}{8})^{4}$

$=$ Rs $24000 \times \frac{2401}{4096} =$ Rs 14068

EXAMPLES XVIII h Page 381

2 See Ex, Art 315

3 Since £$(100 - 12\frac{1}{2})$, or £$87\frac{1}{2}$, is cash payment for a sum of £100, after discount at $12\frac{1}{2}$ per cent has been deducted, we have $\frac{y}{87\frac{1}{2}} = \frac{x}{100}$, which becomes $y = \frac{35}{40}x$ This is the graph formed by joining the origin to the point (40, 35) A convenient scale is 0 1″ to 1 shilling along each axis The required values can easily be read off

4 From Art 316 we see the graph will be linear

Measure time horizontally (1 inch to 10 years), and Amount vertically (1 inch to £40) beginning at £260

The first graph is the line joining the points (6, 260) and (15, 350) The second graph is the line joining the points (5, 330) and (20, 420) In each of these lines the ordinate of any point gives the Amount for the number of years given by the corresponding abscissa

Again, these graphs intersect at a point where $x=25$, $y=450$ Thus each Principal with its Interest amounts to £450 in 25 years

When $x=0$ there is no Interest, thus the Principals will be obtained by reading off the values of the intercepts made by the two graphs on the y-axis These are £200 and £300 respectively

NOTE To obtain the result $y=200$ it will be necessary to continue the y-axis downwards sufficiently far to shew this ordinate

EXAMPLES XIX a Page 384

1-6 See Art 324, Ex 1 7-12 See Art 324, Ex 2

13 Rs 100 stock is worth Rs 95 cash,

Rs 2880 stock sells for Rs $\frac{95}{100}\times 2880$ cash

14 Rs 3500 stock costs Rs 3220 cash,

Rs 100 stock costs Rs $\frac{3220}{3500}\times 100$ cash

15 £285 stock costs £228 cash,

£100 stock costs £$\frac{228}{285}\times 100$ cash

16 £100 Consols is worth £83½ cash,

£855 Consols is worth £$\frac{83\frac{1}{2}}{100}\times 855$ cash

17 £102½ cash buys £100 stock,

£1000 cash buys £$\frac{100}{102\frac{1}{2}}\times 1000$ cash

18 £560 stock costs £480 cash,

£100 stock costs £$\frac{480}{560}\times 100$ cash

19 Rs 100 stock sells for Rs 94½ cash,

Rs 2912 stock sells for Rs $\frac{94\frac{1}{2}}{100}\times 2912$, or Rs $(94\cdot5\times 29\cdot12)$ cash

20 Rs 100 stock costs Rs $125\frac{1}{2}$ cash,

Rs 5782 stock costs Rs $\frac{125\frac{1}{2}}{100} \times 5782$, or Rs $(57\cdot82 \times 125\cdot5)$ cash

21 Rs 100 stock costs Rs $109\frac{1}{2}$ cash,

Rs 3572 stock costs Rs $\frac{109\frac{1}{2}}{100} \times 3572$, or Rs $(35\cdot72 \times 109\cdot5)$ cash

22 On Rs 100 stock the loss is Rs 5,

on Rs 780 stock the loss is Rs $\frac{5}{100} \times 780$

23 On £100 stock the profit is £$3\frac{3}{4}$,

on £650 stock the profit is £$\frac{3\frac{3}{4}}{100} \times 650$

24 Rs $131\frac{1}{4}$ cash buys stock afterwards sold for Rs 133 cash,

hence req^{d} proceeds = Rs $\frac{133}{131\frac{1}{4}} \times 750$

25 £105 cash buys stock afterwards sold for £102 cash,

hence req^{d} cash = £$\frac{102}{105} \times 155$

26 On £100 stock the loss is £$5\frac{1}{2}$,

on £2500 stock the loss is £$\frac{5\frac{1}{2}}{100} \times 2500$

27 On an outlay of Rs $112\frac{1}{2}$ the gain is Rs $(117 - 112\frac{1}{2})$, or Rs $4\frac{1}{2}$,

req^{d} gain = Rs $\frac{4\frac{1}{2}}{112\frac{1}{2}} \times 1187\frac{1}{2}$ = Rs $\frac{9}{225} \times \frac{2375}{2}$ = Rs $\frac{95}{2}$

= Rs 37 8 a

28 On Rs 100 stock the profit is Rs $(107\frac{3}{4} - 101\frac{1}{4})$, or Rs $5\frac{1}{2}$,

on Rs 3720 stock the gain is Rs $\frac{5\frac{1}{2}}{100} \times 3720$ = Rs $\frac{11}{200} \times 3720$

= Rs 213 14 a 6 p

29 As in No 28 we get req^{d} loss = £$\frac{4}{25} \times 1642$ = £50 18 s 4 d

EXAMPLES XIX b Page 386

1-3 See Art 325, Ex 1 4-6 See Art 325, Ex 2

7 1st stock income = Rs $3 \times \frac{1}{64} \times \frac{6370}{1}$ = Rs 335 653,

2nd stock income = Rs $4\frac{1}{2} \times \frac{1}{144} \times \frac{9900}{1}$ = Rs 316 153,

2nd stock gives the greater income by Rs 10 8 a

8 Req^{d} inc = £$2 \times \frac{900}{1} \times \frac{10}{96}$ 9 Req^{d} inc = $\frac{1}{2}$ of £$3\frac{3}{4} \times \frac{400}{11} \times \frac{220}{240}$

10 Req^{d} inc $=\text{Rs } 2\frac{3}{4}\times\frac{7\,8\,6}{1\,0\,0}=\text{Rs } 2\,75\times 7\,86=\text{Rs } 21\,615=\text{Rs } 21\ 9\text{a}\ 9\text{p}$

11 Req^{d} inc $=\text{Rs } 4\frac{1}{4}\times\frac{1\,7\,5\,0}{1\,4\,0}=\text{Rs } \frac{6\,3\,7\,5}{5\,0}=\text{Rs } 113\,839=\text{Rs } 113\ 13\text{a}\ 6\text{p}$

12 Req^{d} inc $=£2\frac{1}{2}\times\frac{500}{82\frac{1}{4}}=£\frac{5000}{329}=£15\ 1975=£15\ 3s\ 11d$

13 Req^{d} amt of stock $=\text{Rs } 100\times\frac{81}{3}$

14 Req^{d} amt of stock $=\text{Rs } 100\times\frac{297}{4\frac{1}{2}}$

15 Req^{d} sum $=\text{Rs } 110\times\frac{60}{5\frac{1}{2}}$

16 Req^{d} sum $=£100\times\frac{24\frac{3}{20}}{5\frac{3}{4}}$

17 Req^{d} sum $=£115\frac{1}{2}\times\frac{80\frac{2}{3}}{5\frac{1}{2}}$

18 Req^{d} sum $=£141\frac{1}{4}\times\frac{17\frac{3}{5}}{5\frac{1}{2}\times\frac{220}{240}}=£\frac{565\times 88\times 2\times 240}{4\times 5\times 11\times 226}=£480$

19 Req^{d} amt $=£100\times\frac{35\frac{20}{80}}{2\frac{1}{2}}$

20 Req^{d} sum $=\text{Rs } 104\times\frac{200}{3}$

21 As in No 18, req^{d} amt $=£132\frac{1}{2}\times\frac{77\frac{9}{10}}{4\frac{1}{2}\times\frac{19}{20}}=£\frac{530\times 41}{9}=£2414\frac{4}{9}$

22 £90 cash buys an income of £4½,
£100 cash buys an income of $£4\frac{1}{2}\times\frac{100}{90}$, giving 5 %

23 As in No 22, £100 cash buys an income of $£3\frac{3}{4}\times\frac{100}{125}$, giving 3 %

24 As in No 22, £100 cash buys an income of $£5\frac{1}{2}\times\frac{100}{145}$, or $£\frac{110}{29}$, giving 3 79 %

25 As in No 22, £100 cash buys an income of $£3\frac{1}{2}\times\frac{100}{78\frac{3}{4}}$, or $£\frac{40}{9}$, giving 4 44 %

26 As in No 22, £100 cash buys an income of $£4\times\frac{100}{119\frac{3}{8}}$, or $£\frac{640}{191}$, giving 3 35 %

27 1st stock income from £100 $=£3\times\frac{100}{86}=£3\ 529$,
2nd stock income from £100 $=£4\times\frac{100}{96}=£4\ 166$
2nd stock is better by £0 64, or 0 64 %

28 1st stock income from £100 $=£4\times\frac{100}{120}=£3\ 174$,
2nd stock income from £100 $=£3\frac{1}{2}\times\frac{100}{108}=£3\ 240$
2nd stock is better by £0 07, or 0 07 %

29 1st stock income from £100 $=£5\times\frac{100}{140}=£3\ 571$,
2nd stock income from £100 $=£6\times\frac{100}{174}=£3\ 448$
1st stock is better by £0 12, or by 0 12 %

30 1st stock income from Rs 100=Rs $4\times\frac{100}{108}$=Rs $\frac{100}{27}$,
2nd stock income from Rs 100=Rs $4\frac{1}{2}\times\frac{100}{117}$=Rs $\frac{100}{26}$
2nd stock is the better
For second part of question,
diff of incomes on Rs 100 invested=Rs $(\frac{100}{26}-\frac{100}{27})$=Rs $\frac{100}{702}$,
diff of incomes on Rs 7020 invested=Rs $\frac{100}{702}\times\frac{7020}{100}$=Rs 10

31 Let Rs x be sum invested by each, the income of the first
=Rs $3\times\frac{x}{81}$, the income of the second=Rs $4\times\frac{x}{112}$,
$$\frac{3x}{81}-\frac{4x}{112}=2, \text{ and } x=1512$$

32 Let Rs x be the req^{d} amt of stock A's income=Rs $3\frac{1}{2}\times\frac{x}{100}$,
B's income=Rs $2\frac{1}{2}\times\frac{x}{100}$, $\frac{3\frac{1}{2}x}{100}-\frac{2\frac{1}{2}x}{100}=100$, and x=Rs 10000

33 If Rs x be the req^{d} price, then Rs x cash produces Rs 4 income,
Rs 100 cash produces Rs $\frac{4}{x}\times100$ income,
$$\frac{4}{x}\times100=5, \text{ and } x=80$$

34 As in No 33, $\frac{2\frac{1}{2}}{x}\times100=2\frac{1}{11}$, and $x=110$

35 As in No 33, $\frac{4\frac{1}{2}}{x}\times100=6$, and $x=75$

36 Let Rs x be req^{d} price, then income from Rs 1600 invested is
$3\times\frac{1600}{x}$, $3\times\frac{1600}{x}=50$, and $x=96$

37 As in No 36, $5\frac{1}{2}\times\frac{24000}{x}=1200$, and $x=110$

38 As in No 36, $5\frac{1}{2}\times\frac{2353}{x}=95\frac{1}{3}$, and $x=135\frac{3}{4}$

39 If £x be req^{d} price, £x cash produces £6 income,
£100 cash produces £$\frac{6}{x}\times100$ income This, after income tax has been paid, becomes $\frac{230}{240}\times\frac{6}{x}\times100$ But this is £5,
$$\frac{230}{240}\times\frac{6}{x}\times100=5, \text{ and } x=115$$

40 4 45 is percentage on £100 cash,
£21 7s 6d, or £21 375 is percentage on £100 $\times \frac{21\frac{3}{4}}{4\,45}$,
or £480 (to nearest £)

41 If £x be req^{d} amount, income from it is £$2\frac{3}{4} \times \frac{x}{92}$,
$2\frac{3}{4} \times \frac{x}{92} = 60$, and x = £2007 (to nearest £)

EXAMPLES XIX c Page 392

1 Rs 100 stock sells for Rs $(105\frac{3}{4} - \frac{1}{4})$, or Rs $105\frac{1}{2}$ cash,
hence req^{d} cash = Rs $6785 \times \frac{105\frac{1}{2}}{100}$

2 Rs 100 stock costs me Rs $(90\frac{7}{8} + \frac{1}{8})$, or Rs 91 cash,
hence req^{d} price = Rs $2750 \times \frac{91}{100}$

3 Rs $(101\frac{1}{4} + \frac{1}{4})$, or Rs $101\frac{1}{2}$ cash buys Rs 100 stock,
Rs $3552\frac{1}{2}$ buys Rs $3552\frac{1}{2} \times \frac{100}{101\frac{1}{2}}$ stock

4 Rs $(93\frac{1}{4} - \frac{1}{8})$, or Rs $93\frac{1}{8}$ cash is realised on Rs 100 stock,
req^{d} amount of stock = Rs $100 \times \frac{6844\frac{11}{16}}{93\frac{1}{8}}$

5 Rs 100 stock costs Rs $(125\frac{1}{4} + \frac{1}{4})$, or Rs $125\frac{1}{2}$ cash,
req^{d} cost = Rs $5782 \times \frac{125\frac{1}{2}}{100}$ = Rs 7256 410

6 Buying price = $91\frac{3}{8} + \frac{1}{8}$, or $91\frac{1}{2}$, selling price = $90\frac{1}{8} - \frac{1}{8}$, or 90
loss on Rs 100 stock = Rs $1\frac{1}{2}$, hence req^{d} loss = Rs $1\frac{1}{2} \times \frac{2500}{100}$

7 Gain on buying and selling Rs 100 stock = Rs (108 − 105), or Rs 3
Half year's dividend on Rs 100 stock = Rs $1\frac{3}{4}$,
total gain on Rs 100 stock = Rs $4\frac{3}{4}$
Hence on outlay of Rs 105, gain is Rs $4\frac{3}{4}$
„ „ Rs 3500, gain is Rs $4\frac{3}{4} \times \frac{3500}{105}$, or Rs 158 5a 3p

8 Gain on buying and selling Rs 100 stock = Rs $(93\frac{1}{4} - 91\frac{1}{4})$ = Rs 2
1 quarter's dividend on Rs 100 stock = Re $\frac{5}{8}$,
total gain on Rs 100 stock = Rs $2\frac{5}{8}$,
hence on outlay of Rs $91\frac{1}{4}$, gain is Rs $2\frac{5}{8}$,
„ Rs 4380, „ Rs $2\frac{5}{8} \times \frac{4380}{91\frac{1}{4}}$, or Rs 126

9 Rs 100 stock costs Rs $96\frac{1}{4}$ cash,

req^{d} income = Rs $2\frac{3}{4} \times \frac{4200}{96\frac{1}{4}}$, or Rs 120

10 Rs 100 stock costs Rs 104 cash, Rs $3\frac{1}{4}$ income costs Rs 104 cash,

hence req^{d} sum = Rs $400 \times \frac{104}{3\frac{1}{4}}$, or Rs 12800

11 £100 stock costs £$103\frac{1}{8}$ cash, £4 income costs £$103\frac{1}{4}$ cash,

hence req^{d} sum = £$275 \times \frac{103\frac{1}{8}}{4} = £\frac{226875}{32}$, or £7090

12 £100 stock costs £$103\frac{1}{2}$ cash,

£$3 \times \frac{200}{406}$ is net income from £$103\frac{1}{2}$ cash,

hence req^{d} sum = £$500 \times \frac{103\frac{1}{2}}{3 \times \frac{200}{406}} = £\frac{2070000}{113}$, or £18319

13 Let £x be req^{d} price, then £$(x + \frac{1}{4})$ cash produces £$4\frac{3}{4}$ income,

hence £100 cash produces £$100 \times \frac{4\frac{3}{4}}{x+\frac{1}{4}}$ income, £$100 \times \frac{4\frac{3}{4}}{x+\frac{1}{4}} = 5$,

or $100 \times 4\frac{3}{4} = 5(x + \frac{1}{4})$, hence $x + \frac{1}{4} = 95$, and $x = 94\frac{3}{4}$

14 Rs 100 stock can be bought for Rs $(100 \times \frac{801}{806\frac{7}{8}})$ + brokerage,

$i.e.$ Rs $92\frac{1}{2}$ + brokerage, or Rs $92\frac{5}{8}$

15 Income from first stock = Rs 3×60 = Rs 180

Sale of first stock realises Rs 60×91, or Rs 5460 cash

Hence income from second stock = Rs $4 \times \frac{5460}{1170}$ = Rs 168,

req^{d} loss = Rs $(180 - 168)$, or Rs 12

16 Income from first stock = Rs $3\frac{1}{2} \times 55$ = Rs $192\frac{1}{2}$

Sale of first stock realises Rs $91\frac{1}{8} \times 55$ cash

Hence income from second stock = Rs $4 \times \frac{91\frac{1}{8} \times 55}{101\frac{1}{4}}$ = Rs 198,

req^{d} change = Rs $(198 - 192\frac{1}{2})$, $i.e.$ Rs $5\frac{1}{2}$ gain

17 Income from first stock = Rs $5 \times \frac{1425}{1117}$ = Rs 620

Sale of first stock realises Rs $125 \times \frac{1425}{1117}$, or Rs 15500

Hence income from second stock = Rs $3 \times \frac{15500}{9375}$ = Rs 500,

req^{d} change is Rs $(620 - 500)$, $i.e.$ Rs 120 loss

18 £1365 cash buys £$100 \times \frac{1365}{91}$ stock, or £1500 stock

£1000 of the stock realises £$93\frac{1}{2} \times \frac{1000}{100}$ cash, or £935 cash

The remaining £500 stock realises £$85 \times \frac{500}{100}$ cash, or £425 cash,

req^{d} loss = £$(1365 - 935 - 425)$, or £5

19 £4340 cash buys £100 $\times \frac{4340}{108\frac{1}{2}}$ stock, or £4000 stock,
my first income is £3$\frac{1}{2}$ × 40, or £140
The £4000 stock realises £110 × 40, or £4400 cash
£4400 cash then buys an income of £5$\frac{1}{2}$ × $\frac{4400}{1\ 1}$, or £200,
req^{d} increase = £(200 − 140) = £60

20 £26180 cash buys £100 × $\frac{26180}{93\frac{1}{2}}$, or £28000 stock.
his first income is £3 × 280, or £840
£14000 of this stock realises £92$\frac{1}{4}$ × 140, or £12915 cash, which purchases in the 4 p c 's an income of £4 × $\frac{12915}{97}$, or £532 577
The remaining £14000 stock brings in £$\frac{1}{2}$ of 840, or £420 income,
req^{d} difference = £(532 577 + 420 − 840), or £112 577 increase

21 £500 R^{y} Stock at 95 costs £475,
brokerage at $\frac{1}{2}$ % on £475 = £2 7*s* 6*d*

22 £500 R^{y} Stock at 128$\frac{1}{2}$ costs £642 10*s*,
brokerage at $\frac{1}{2}$ % on £642 10*s* = £3 4*s* 3*d*
£500 N T D Stock at 111$\frac{3}{4}$ costs £558 15*s*,
brokerage at $\frac{1}{2}$ % on £558 15*s* = £2 15*s* 11*d*

23 £800 Consols at 91 costs £728, brokerage at $\frac{1}{8}$ % on £800 = £1
£650 R^{y} Stock at 110$\frac{3}{4}$ realises £719 17*s* 6*d*,
brokerage at $\frac{1}{2}$ % on £719 17*s* 6*d* = £3 12*s*

24 £2375 R^{y} Stock at 125 realises £2968 15*s*,
brokerage at $\frac{1}{2}$ % on £2968 15*s* = £14 16*s* 11*d*
£4000 India Stock at 97$\frac{1}{2}$ costs £3900,
brokerage at $\frac{1}{2}$ % on £4000 = £5

25 £3600 Consols at 89$\frac{3}{8}$ realises £3217 10*s*,
brokerage at $\frac{1}{8}$ % on £3600 = £4 10*s*
£2700 R^{y} Stock at 119$\frac{1}{2}$ costs £3226 10*s*,
brokerage at $\frac{1}{2}$ % on £3226 10*s* = £16 2*s* 8*d*

26 £400 N T Stock at 103$\frac{3}{4}$ costs £415,
brokerage at $\frac{1}{2}$ % on £415 = £2 1*s* 6*d*

27 (i) £300 India Stock at 93 costs £279,
brokerage at $\frac{1}{8}$ % on £300 = 7*s* 6*d*

(ii) £400 Transvaal Stock at 95$\frac{1}{2}$ costs £382,
brokerage at $\frac{1}{4}$ % on £400 = £1

(iii) £500 Mexican Ry Stock at 95 costs £475,
brokerage at $\frac{1}{2}$ % on £475 = £2 7*s* 6*d*

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1 Rs $38\frac{3}{4} \times 500$

2 Rs $(200 - 1\frac{3}{16}) \times 60$

3 Cost of £1 shares = (£2 17*s* 6*d* + $4\frac{1}{2}$*d*) × 44 = £127 6*s* 6*d*
Cost of £5 shares = (£6 6*s* 3*d* + 9*d*) × 80 = £508

4 Rs $(15 + 2\frac{1}{2}) \times 50$

5 (£2 + £$\frac{3}{4}$ − 9*d*) × 250

6 Rs 355 − (Rs 15 + Rs $2\frac{1}{2}$ + 4 a)

7 (i) Rs $4\frac{1}{2} \times 35$ (ii) Rs $6\frac{1}{2} \times \frac{50}{100} \times 47$
(iii) (Rs $7\frac{1}{2} \times \frac{150}{100}$ + 8 a) × 75

8 Req^{d} dividend = Rs $100 \times 20 \times \frac{3}{100} \times \frac{19}{15}$ = Rs 58 7 a

9 (i) On £5 the dividend is $\frac{10}{100}$ of £3, or £$\frac{3}{10}$,
req^{d} percentage = $\frac{100}{5} \times \frac{3}{10}$, or £6

(ii) On £13$\frac{1}{2}$ the dividend is $\frac{8}{100}$ of £9,
req^{d} percentage = $\frac{100}{13\frac{1}{2}} \times \frac{8}{100}$ of £9, or £5 6*s* 8*d*

(iii) On £36 the dividend is 17*s* × 2,
req^{d} percentage = 17*s* × 2 × $\frac{100}{36}$, or £1 14*s* 5*d*

10 (i) Req^{d} no of shares = $\frac{£375}{£7\frac{1}{2}}$ (ii) Req^{d} cost price = £$7\frac{1}{2} \times 20$

(iii) Req^{d} dividend = £$5\frac{1}{2} \times \frac{5 \times 75}{100}$

11 (i) Price (with brokerage) per share = £$10\frac{3}{4}$ + 1*s* 3*d* = £$10\frac{13}{16}$,
req^{d} no of shares = £$605\frac{1}{2} - 10\frac{13}{16}$

(ii) Req^{d} cost = £$10\frac{13}{16} \times 36$ (iii) Req^{d} dividend = $\frac{8\frac{3}{4}}{100}$ of £6 × 50

12 On £100 of first stock he realises £$96\frac{1}{4}$ If £x be the price of each share, with £$96\frac{1}{4}$ cash, he buys $\frac{96\frac{1}{4}}{x}$ shares His income is now £$4\times\frac{96\frac{1}{4}}{x}$, and this by the question is £$\frac{105}{100}\times 2\frac{3}{4}$

$$\frac{4\times 96\frac{1}{4}}{x}=\frac{105}{100}\times 2\frac{3}{4},\text{ and }x=£133\frac{1}{3}$$

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1 I buy £$5520\times\frac{100}{96}$, or £6000 Consols,
£6000 Consols must sell for £5730 cash,
or £100 „ „ £$95\frac{1}{2}$ cash

2 Req^{d} income $=£2\frac{3}{4}\times\frac{1200}{95\frac{3}{4}}=£\frac{13200}{383}=£34\ 465$

3 Income on investing Rs 100 in 1st stock $=$Rs $4\frac{1}{2}\times\frac{100}{105}=$Rs 2 96053,
„ „ Rs 100 „ 2nd „ $=$Rs $2\frac{1}{2}\times\frac{100}{85}=$Rs 2 94118,
the first is more profitable
For second part of question, we have
diff for Rs 100 invested $=$Re 0 01935,
req^{d} diff $=$Re $0\ 01935\times 32\ 30=$Re $0\ 625$

4 Let Rs x be req^{d} price, then income $=$Rs $2\frac{3}{4}\times\frac{6200}{x+\frac{1}{8}}$ (allowing for brokerage),

$$2\frac{3}{4}\times\frac{6200}{x+\frac{1}{8}}=176,\text{ or }x+\frac{1}{8}=\frac{2\frac{3}{4}\times 6200}{176},\text{ whence }x=96\frac{3}{4}$$

5 Let £x be the req^{d} price, then income from £100 cash
is £$7\times\frac{100}{x+\frac{1}{4}}$ (allowing for brokerage),

$$7\times\frac{100}{x+\frac{1}{4}}=4,\text{ whence }x+\frac{1}{4}=\frac{700}{4},\text{ and }x=174\frac{3}{4}$$

6 Income $=$Rs $3\frac{1}{2}\times\frac{75}{100}$
For second part of question
on Rs 90 outlay, the loss is Rs (90 - 87), or Rs 3,
on Rs 7500 „ „ Rs $3\times\frac{75}{100}$

7 Let Rs x be req^{d} price Then Rs 115 cash buys Rs $4\frac{1}{2}\times\frac{115}{x}$ income

$$\frac{4\frac{1}{2}\times 115}{x}=5,\text{ and }x=103\frac{1}{2}$$

The half-yearly dividend $=\frac{1}{2}$ of Rs $5\times\frac{2340}{115}=$Rs 51

8 Let £1x be his capital Income from 1st stock $=£2\frac{1}{4}\times\frac{x}{90}$,

income from 2nd stock $=£3\frac{1}{2}\times\frac{3x}{105}$

total income $=£\left(\frac{2\frac{1}{4}x}{90}+\frac{3\frac{1}{2}\times 3x}{105}\right)=£\frac{x}{8}$

Now $\frac{x}{8}=\frac{1}{32}$ of $4x$, *i e* his income $=\frac{1}{32}$ of his capital,
or $3\frac{1}{8}$ % of his capital

9 Req^{d} cost $=£59\frac{7}{8}\times 2\ 25=£(60-\frac{1}{8})\times 2\ 25=£(135-0\ 281)$
$=£134\ 719$

Brokerage $=\frac{1}{100}$ of £134 719 $=£0\ 674$ total cost $=£135\ 393$

10 Total sum due to broker $=£994\ 19s+£2\ 11s=£997\ 10s$

req^{d} amt of stock $=£100\times\frac{997\ 5}{99\ 75}=£1000$

11 Let Rs x be the req^{d} sum Income is Rs $6\times\frac{x}{141}\times\frac{188}{192}$,
and this is Rs 1200

$6\times\frac{x}{141}\times\frac{188}{192}=1200$, and $x=\frac{1200\times 141\times 192}{6\times 188}=$ Rs 28800

12 If £x be the amt of 3 p c stock, income is $£3\times\frac{x}{100}\times\frac{230}{240}$,
and this $=£142\frac{1}{2}$

Hence $x=£15400$ This realises $£78\frac{3}{4}\times 154$, which is invested in 4 p c stock Allowing for brokerage and income tax, it yields an income of $£4\times\frac{78\frac{3}{4}\times 154}{102\frac{1}{2}}\times\frac{230}{240}$, or £453 549, or £453 11s the req^{d} change is £10 16s gain

13 Income from the 3 p c's $=$Rs $3\times\frac{5000}{100}\times\frac{188}{192}=$Rs 146 14$a$

" " $3\frac{1}{2}$ " $=$Rs $3\frac{1}{2}\times\frac{5000}{104}=$Rs. 156 4$a$

the second was the more advantageous by Rs 9 6a

14 £4376 G W R stock at 124 costs £5426 4s 10d
Brokerage at $\frac{1}{2}$ % on £5426 4s 10d $=£27$ 2s 8d

15 Suppose he invests Rs x

Income from 3 p c's $=3\times\frac{1}{2}\times\frac{x}{97\frac{1}{2}}$, income from 4 p c's $=4\times\frac{1}{2}\times\frac{x}{125}$,

$$\frac{3x}{2\times 97\frac{1}{2}}+\frac{4x}{2\times 125}=510, \text{ and } x=16250$$

16 Let Rs x be invested in each stock

Income from 6 p c 's $= 6 \times \frac{x}{126}$, income from 9 p c 's $= 9 \times \frac{x}{210}$,

$$\frac{6x}{126} - \frac{9x}{210} = 225, \text{ and } x = 47250$$

17 Let £x be amt necessary, £$\frac{9x}{10}$ remain after paying legacy duty

income from 4 p c 's (allowing for income tax)

$$= 4\tfrac{1}{2} \times \frac{9x}{10 \times 103\frac{1}{2}} \times \frac{230}{240},$$

$$4\tfrac{1}{2} \times \frac{9x}{10 \times 103\frac{1}{2}} \times \frac{230}{240} = 60, \text{ and } x = 1600$$

18 Amt of 3 p c. stock $= 100 \times \frac{300}{3} =$ £10000

£5000 stock realises £92 × 50, or £1600 If £x be req^{d} percentage, then £4600 brings in an income of £$x \times \frac{4600}{46}$, or £100x

Since the remaining £5000 stock brings in an income of £150, we have $150 + 100x = 300 + 50$, and $x = 2$ %

19 Let x shillings be the rate per £

From first stock income $= £2\tfrac{1}{2} \times \frac{4560}{100} \times \frac{20 - x}{20}$

£4560 stock realises £85 × 45 6,

income from second stock $= 1 \times \frac{85 \times 45\,6}{114} \times \frac{20 - x}{20}$

$$\frac{4 \times 85 \times 45\,6}{114} \times \frac{20 - x}{20} - \frac{21}{2} \times \frac{1560}{100} \times \frac{20 - x}{20} = 209,$$

or $$\frac{20 - x}{20}\left(\frac{1 \times 85 \times 45\,6}{114} - \frac{21}{2} \times \frac{1560}{100}\right) = 209,$$

or $$\frac{20 - x}{20}(136 - 114) = 209,$$

$$(20 - x) \times 22 = 418 \text{ and } x = 1$$

Aliter Income from 2½ p c 's $=$ £2½ × 45 6 $=$ £114 (without tax)

£4560 stock realises £85 × 45 6, or £3876

This brings in an income of £4 × $\frac{3876}{114}$, or £136 (without tax),

difference of incomes (without tax) $=$ £22,

hence the tax on £22 is (£22 − £20 18s), or 22s,

and tax is 1s in the £

20 First income = Rs 8×50 = Rs 400
The 50 shares realise Rs 9000, and this buys $\frac{9000}{96}$ shares at Rs 50
These $\frac{9000}{35}$ shares produce an income of Rs $3\frac{1}{2} \times \frac{50}{100} \times \frac{1800}{7}$,
or Rs 450 req^{d} difference = Rs 50 gain

21 In 1st case, Rs $115\frac{1}{2}$ cash produces Rs $5\frac{1}{2}$ income,

i e Rs 100 „ „ Rs $5\frac{1}{2} \times \frac{100}{115\frac{1}{2}}$, or Rs $\frac{1100}{231}$ income

In 2nd case, Rs $7\frac{3}{4}$ cash produces Rs $3\frac{1}{2} \times \frac{10}{100}$ income,

i e Rs 100 „ „ Rs $3\frac{1}{2} \times \frac{10}{100} \times \frac{100}{7\frac{3}{4}}$, or Rs $\frac{700}{155}$ income

rates of interest are as $\frac{1100}{231}$ $\frac{700}{155}$, or as 155 147

Alter The incomes from Re 1 invested in each company are proportional to the respective rates of interest

Re 1 invested in first company produces Re $\frac{5\frac{1}{2}}{115\frac{1}{2}}$, or Re $\frac{11}{231}$ income

Re 1 „ „ second „ „ Re $\frac{3\frac{1}{2}}{77\frac{1}{2}}$, or Re $\frac{7}{115}$ „

rates of interest are as $\frac{11}{231}$ $\frac{7}{115}$, or as 145 147

22 The first income (free of tax) = £8 × 38 4 = £307 4*s*
On £3840 stock he realises £$187\frac{1}{2} \times 38$ 4
His second income (free of tax) = £$4\frac{1}{2} \times \frac{187\frac{1}{2} \times 38\ 4}{108}$ = £300
Hence difference (free of tax) = £7 4*s*
tax on £7 4*s* = £7 4*s* − £6 18*s* = 6*s*,
whence tax = 10*d* in the £

23 His first income = Rs $2\frac{3}{4} \times \frac{80000}{94} \times \frac{188}{100}$ = Rs 2291 666
On selling out he realises Rs $80000 \times \frac{99}{94}$
His second income = Rs $2\frac{1}{4} \times \frac{80000 \times 99}{72 \times 94}$ = Rs 2632 978
difference = Rs 341 312 = Rs 341 5 a

24 Let £x be spent on the Stock
Net income from this = £$3 \times \frac{x}{97\frac{7}{8}} \times \frac{19}{20}$

$\frac{3 \times x \times 19}{97\frac{7}{8} \times 20} = 52$, and $x = \frac{52 \times 783 \times 20}{8 \times 19 \times 3} = \frac{2610 \times 13}{19}$ = £1785 7894

Adding 1*s* or £0 05 for Contract Note Stamp,
req^{d} answer = £1785 8394 = £1785 16*s* 9*d*

25 He realised Rs $(100+150)\times 100$, or Rs 25000 Each Rs 10 share cost Rs $\frac{83\frac{1}{3}}{100}\times 10$, he bought $\left(25000-\frac{83\frac{1}{3}}{10}\right)$, or 3000 shares

26 £500 Canada Stock costs £$104\frac{1}{4}\times 5$, or £$521\frac{1}{4}$
Thus £$478\frac{3}{4}$ is left to be invested in N Z Stock
This buys £$100\times\frac{478\frac{3}{4}}{97\frac{3}{4}}$, or £489 770, or £489 15s 5d N Z Stock

27 £20000 Jamaica Stock costs £$101\frac{1}{8}\times 200$, or £20225
£10000 Cardiff Stock costs £97×100, or £9700
£20075 remains This buys £$100\times\frac{200075}{97\frac{1}{4}}$,
or £20642 Bristol Stock
Net income on £50000 invested
$=£(3\frac{1}{2}\times 200+3\times 100+3\times 206\ 42)\times\frac{1}{20}$
$=£(700+300+619\ 26)\times\frac{1}{20}=£1619\ 26\times\frac{1}{20}=£1538\ 297$
average income per cent $=£\frac{15\ 38297}{5}=£3\ 08$

28 Rs 40000 stock costs him Rs 65×400, or Rs 26000
He owes the bank 4 % of $\frac{40}{100}$ of Rs 26000, or Rs 416
He receives Rs $2\frac{1}{4}\times 400$, or Rs 900 dividend
By sale of Rs 40000 stock, he realises Rs 70×400, or Rs 28000
his profit is Rs $(28000+900-26000-416)$, or Rs 2484
Now Rs 2484 is profit on an outlay of Rs 26000,
giving Rs $\frac{2484}{260}$ profit on Rs 100 outlay, or 9 6 %

MISCELLANEOUS EXAMPLES V Page 401

A

1 2 2046 lbs $=1$ Kg, 1 lb $=\frac{1}{2\ 2046}$ Kg,
1 ton or 2240 lbs $=\frac{2240}{2\ 2046}$ Kg $=1016$ Kg

2 10 tons 13 cwt 74 lbs $=(10+\frac{13}{20}+\frac{74}{2240})$ tons $=10\frac{153}{224}$ tons
req^{d} cost $=£1\frac{1}{6}\times 10\frac{153}{224}=£\frac{7}{6}\times(10+\frac{153}{224})=£\frac{70}{6}+\frac{7\times 153}{6\times 224}$
$=£11\frac{2}{3}+£\frac{51}{64}=£11\frac{2}{3}+3\frac{3}{4}d\times 51=£11\ 13s\ 4d+15s\ 11\frac{3}{4}d$
$=£12\ 9s\ 3d$ to nearest penny

3 Let Rs x be the partner's share of the profits
Then $0\cdot24\times x=7800$, and $x=32500$, req^{d} fraction $=\frac{32}{48}\frac{50}{75}=\frac{2}{3}$

4. £5 17s 6d $=117\frac{1}{2}s$, 2s 3d $=2\frac{1}{4}s$,
area of room $=\frac{117\frac{1}{2}}{2\frac{1}{4}}$ sq yds $=\frac{470}{9}$ sq yds $=470$ sq ft,
and req^{d} breadth $=\frac{470}{23\frac{1}{2}}$ ft $=20$ ft

5 As in Art 292, Ex 1, req^{d} S P $=\frac{114}{95}$ of Rs 80 $=$ Rs 96

6 Let Rs x be the req^{d} amount of stock His income is Rs $3\frac{3}{4}\times\frac{x}{100}$
$\frac{3\frac{3}{4}\times x}{100}=$ Rs $84\frac{6}{16}$, and $x=$ Rs 2250

B

7 Cost for 20 yds $=$ £2 11s 5d $=$ £2$\frac{137}{240}$
cost for 1 yd $=\frac{1}{20}$ of £2$\frac{137}{240}$,
no of yds in perimeter $=\frac{£339\frac{1}{20}}{\frac{1}{20}\text{ of }£2\frac{137}{240}}=2640$,
and no of yds in side $=660$, req^{d} acreage $=\frac{660\times660}{4840}=90$

8 Total C P $=240$ a, total S P $=250$ a
(i) actual gain $=10$ a, (ii) percentage gain $=\frac{10}{240}\times100=4\frac{1}{6}$

9 112 lbs of coffee cost 168s, 52 lbs of coffee, or 12 lbs of tea cost 168s $\times\frac{52}{112}$,
22 lbs of tea cost, or 572 lbs of sugar cost $\frac{168s\times52\times22}{112\times12}$, or 143$s$
req^{d} weight of a cask of sugar costing 42s $=572$ lbs $\times\frac{42}{143}=168$ lbs

10 Let the req^{d} area $=x$ sq cm, then $1800\times x=350\times0\cdot02$,
whence $x=\frac{7}{1800}$ Now $\frac{7}{1800}$ sq cm $=\frac{7}{18}$ sq mm $=0\cdot39$ sq mm

11 Convenient scales are 0·1″ to 1d horizontally, and 0·1″ to 1 lb vertically Since 1 cwt $=112$ lbs, and £1 6s 8d $=320d$, as in Art 277, Example, $y=\frac{112}{320}x$, or $y=\frac{7}{20}x$ Join the origin to the point (20, 7), and the graph is obtained The required values may then be read off

12 From Art 313,

the amount in 3 yrs $=\text{Rs } 1756\left(1+\frac{2\frac{1}{4}}{100}\right)^3=\text{Rs } 1756\times 1\ 0225^3$

Rs		Rs		Rs	
1756		1795 510		1835 908	98
1 022	5		1 0225		1 0225
1756		1795 51		1835 908	98
35 12		35 910	2	36 718	18
3 512		3 591	02	3 671	82
878		897	76	917	95
1795 510		1835 908	98	1877 216	93

req^{d} C I $=$Rs 1877 3a 6p $-$Rs 1756$=$Rs 121 3a 6p

C

13 Req^{d} fraction $=\frac{\text{Rs } 20\ 11\text{a } 6\text{p}}{\text{Rs } 121\ 14\text{a}}=\frac{\text{Rs } 20\frac{3}{32}}{\text{Rs } 121\frac{7}{8}}=\frac{17}{100}=0\ 17$

14

9 07,07 (3 0117596
9 $=3\ 011760$
601 | 707
6021 | 10600
60227 | 457900
60234 | 35911
5749
373

15 Interest $=1\frac{1}{2}\text{a}\times 52$ on 240a
$=78$ on 240
$=\frac{78}{240}\times 100$ on 100
$=32\frac{1}{2}\ \%$

16 Req^{d} fraction $=\frac{16\frac{1}{4}\times 12\frac{1}{6}\text{ sq ft}}{21\frac{2}{3}\times 18\frac{1}{4}\text{ sq ft}}=\frac{1}{2}$

17 (8+10+12), or 30 shovelfuls are thrown in per 1 min ,
the first man would take 90 min $\times\frac{30}{8}$, the second, 90 min $\times\frac{30}{10}$,
the third, 90 min $\times\frac{30}{12\frac{1}{2}}$, or $337\frac{1}{2}$ min , 270 min , and 225 min
respectively , *i e* $5\frac{5}{8}$ hours, $4\frac{1}{2}$ hours, and $3\frac{3}{4}$ hours respectively

18 2nd S P $=$1st S P $\times\frac{\text{Rs } 6\ 3\text{a}}{\text{Rs } 5\ 1\text{a}}=$1st S P $\times\frac{99}{81}=\frac{11}{9}$ of S P

Also 1st S P $=135\ \%$ of C P , 2nd S P $=\frac{11}{9}$ of $135\ \%$ of C P ,
or 2nd S P $=165\ \%$ of C P , hence req^{d} gain $=65\ \%$

(See Art 292)

D

19 Volume of each brick $=\frac{9\times4\frac{1}{2}\times3}{1728}$ cu ft,

weight of each brick $=\frac{9\times4\frac{1}{2}\times3}{1728}\times145$ lbs

Hence, if x be req^{d} no of bricks, $\frac{9\times4\frac{1}{2}\times3}{1728}\times145\times x=5\times2240$,

whence $x=\frac{5\times2240\times1728}{9\times4\frac{1}{2}\times3\times145}=\frac{2240\times128}{9\times29}=1100$ (nearly)

20 In walking $4\frac{1}{2}$ miles, B can give A $\frac{1}{2}$ mile start

„ 1 mile, B „ A $\frac{1}{9}$ „ „

or „ 1 yd, B „ A $\frac{1}{9}$ yd „

„ 1350 yds, B „ A $\frac{1}{9}$ of 1350 yds, or 150 yds start

21 Let x shillings be req^{d} C P, the marked price $=\frac{130}{100}$ of x shillings,

and S P $=\frac{95}{100}$ of $\frac{130}{100}$ of x shillings Also £8 4s 8d $=164\frac{2}{3}s$

$\frac{95\times130\times x}{100\times100}=164\frac{2}{3}$, and $x=\frac{494\times100^{2}}{3\times95\times130}=133\frac{1}{3}$, $i.e.$ £6 13s 4d

22 2 cwt 26 lbs $=250$ lbs, req^{d} cost $=250\times0\,4536\times4\,75$ fr

$=1000\times0\,1134\times4\,75$ fr $=113\,4\times4\,75$ fr $=539$ fr (nearly)

E

23 1st dividend $=$ Rs $4\times\frac{9000}{100}=$ Rs 360

Rs 9000 stock realises Rs $112\frac{1}{2}\times\frac{9000}{100}$, or Rs 10125,

2nd dividend $=$ Rs $5\frac{1}{2}\times\frac{10125}{168\frac{3}{4}}=$ Rs 330, giving Rs 30 loss

24 Let Rs x be one part, then Rs $(1130-x)$ is the other part

$\frac{7x}{100}+\frac{2(1130-x)}{100}=\frac{5}{100}$ of 1130, and $x=678$,

hence we obtain Rs 678 at 7 %, and Rs 452 at 2 %

26 Req^{d} ratio $=\frac{\text{Rs } 269\ 8\text{a}}{\text{Rs } 500\ 8\text{a}}=\frac{\text{Rs } 269\frac{1}{2}}{\text{Rs } 500\frac{1}{2}}=\frac{7}{13}$

27

	£38 6
	47
	1544
	270 2
	1814 2
440 yds = ¼ mi	9 65
220 yds = ⅛ mi	4 825
55 yds = ¼ of 220 yds	1 206 | 25
55 yds = ¼ of 220 yds	1 206 | 25
5 yds = 1/11 of 55 yds	109 | 66
	1831 197 | 16

giving £1831 4*s*

28 Let Rs r be req^{d} price
Then
$$30r+\frac{3r}{4}\times 20=\frac{135}{100}\text{ of }5000,$$
and $x=150$

29.
$$\begin{cases}2\text{ men with 1 boy do }\frac{1}{6}\text{ of the work in 1 day,}\\ 1\text{ man }\ \ 2\text{ boys }\ \frac{1}{6}\ \ \ \ \ 1\ \ \end{cases}$$
$$\begin{cases}4\text{ men with 2 boys do }\frac{2}{6}\text{ of the work in 1 day,}\\ 1\text{ man }\ \ 2\ \ \ \frac{1}{6}\ \ \ \ \ 1\ \ \end{cases}$$
by subtraction, 3 men do $\frac{2}{6}-\frac{1}{6}$, or $\frac{7}{30}$ of the work in 1 day,
that is, 1 man does $\frac{7}{90}$ of the work in 1 day
1 boy does $\frac{1}{6}-\frac{14}{90}$, or $\frac{4}{90}$ of the work in 1 day

Since their daily rates of work are proportional to their weekly rates, the wages of a boy must be Rs $7\times\frac{\frac{4}{90}}{\frac{7}{30}}$=Rs 4

30 Let x be the original population of each part,
then $\frac{80x}{100}+\frac{115x}{100}=39390$,
$195x=39390\times 100$, and $x=20200$

F

31 30 eggs are bought for 25 a and sold for 36 a,
11 a is gained on an outlay of 25 a,
i e 44 a " " 100 a, or 44 %

32 His estimate of 30 in is really 32 in, of 1 in is really $\frac{32}{30}$ in, of 1 sq in is really $\frac{32}{30}\times\frac{32}{30}$ sq in Now 2 ac 3 r =11 r,
his estimate of 11 r is really $\frac{32}{30}\times\frac{32}{30}\times 11$ r =12 516 r =3 13 ac

33 His first income $=\text{Rs } 2\frac{3}{4} \times \frac{10000}{100} = \text{Rs } 275$

The stock realises Rs 10000

If he invests Rs x in the 4 per cent stock, his income is Rs $4 \times \frac{x}{140}$

$$4 \times \frac{x}{140} = 275, \text{ and } x = 9625,$$

he retains Rs (10000 − 9625) or Rs 375

34. Time = 73 days Interest $= £3\frac{1}{2} \times \frac{389\frac{1}{2}}{100} \times \frac{73}{365}$

$$= £\frac{7}{2} \times \frac{1168}{300} \times \frac{1}{5} = £\frac{8176}{3000} = £2\,725 = £2\ 14s\ 6d$$

Amount $= £389\ 6s\ 8d + £2\ 14s\ 6d = £392\ 1s\ 2d$

35 Cutting the 17 in edge from the 18 in edge, the 9 in edge from the 30 in edge, he gets 3 pieces out of each sheet, and requires 12 sheets Each sheet has an area of (18×30) sq in, or $3\frac{3}{4}$ sq ft

Hence 12 sheets cost $2a \times 3\frac{3}{4} \times 12$, or 90a The area of the 36 pieces is $\frac{17 \times 9}{144}$ sq ft $\times 36$, and their value is $3a \times \frac{17 \times 9}{144} \times 36$, or $114\frac{3}{4}a$ His profit is therefore $23\frac{3}{4}a$ on 90a outlay, or $27\frac{1}{2}\%$

36 Let the man's daily wage be $7x$ annas, the wife's $4x$ annas, the son's $3x$ annas, then $7x \times 2 + 4x \times 3\frac{1}{2} + 3x \times 4 = 80$, and $x = 2a$, the man's wage is 14a, the woman's 8a, the boy's 6a.

G

37 103 tons 5 cwt 3 qrs

$= (103 + \frac{5}{20} + \frac{3}{20 \times 4})$ tons

$= 103\ 2875$ tons

req^d price

$= £5\ 425 \times 103\ 2875$

$= £560\ 335 = £560\ 6s\ 8d$

103·2875	5
	5 425
516 4375	5
41 3150	0
2 0625	7
516	4
560 3346	6

Volume of casting $= \frac{103\ 28 \cdot 5 \times 2240}{488} = \frac{103\ 28 \cdot 5 \times 28}{61}$

$$= \frac{2892\ 03}{61} = 474\ 1 \text{ cu ft}$$

38 Volume of wood $= (26 \times 19 \times 18 - 25 \times 18 \times 17)$ cu in

$= 18(26 \times 19 - 25 \times 17)$ cu in $= 18 \times 69$ cu in $= \frac{18 \times 69}{17 \cdot 8}$ cu ft,

weight of box $= \frac{18 \times 69}{17 \cdot 8} \times 40$ lbs $= \frac{117}{4}$ lbs $= 28\frac{3}{4}$ lbs

39 Let each woman do $2x$ units of work per day,
then each man does $3x$ „ „
50 men working for 80 days do $3x \times 50 \times 80$, or $12000x$ units,
and the cost is $5\frac{1}{2}s \times 50 \times 80$, or £1100
Again, 20 men and 30 women do $(3x \times 20 + 2x \times 30)$,
or $120x$ units per day,
they would do $12000x$ units in 100 days,
and the cost would be $(5\frac{1}{2}s \times 20 + 2\frac{3}{4}s \times 30) \times 100$, or £962 10$s$,
the req^{d} difference is £1100 − £962 10s, or £137 10s less

40 Let £P be req^{d} sum, then from Art 313, $P \times (\frac{105}{100})^3 = 308\frac{14}{20}$,
$P = 308\frac{7}{10} \times (\frac{100}{105})^3 = \frac{3087}{10} \times (\frac{20}{21})^3 = \frac{800}{3} = £266\frac{2}{3}$

41 Cost Price = Rs 38, Selling Price = Rs $38 \times \frac{105}{100}$
If Rs x be the "marked" price, then Selling Price = Rs $\frac{95x}{100}$,
$\frac{95x}{100} = 38 \times \frac{105}{100}$, and x = Rs 42

42 Suppose he invests Rs v in the first stock, and Rs 23100 − v in the second His income from the first stock = Rs $3 \times \frac{x}{81}$,
from the second = Rs $4\frac{1}{2} \times \frac{23100 - x}{135}$,
$\frac{3v}{81} + \frac{4\frac{1}{2}}{135}(23100 - v) = 800$, or $\frac{v}{27} + \frac{23100 - x}{30} = 800$,
x = 8100, giving Rs 8100 at 81, and Rs 15000 at 135

H

43

1 2345	
1 2345	
1 2345	
2469	0
370	35
49	38
6	17
1 5239	90
1 2345	
1 5239	90
3047	98
457	20
60	96
7	62
1 8813	66

giving 1 8814

44 Exp^{n} $= \frac{(4\frac{1}{3} - 1\frac{1}{7}) \times 12}{(6\frac{2}{3} + 4\frac{2}{7}) \times 12} - \frac{21 - 194}{93 + 87}$
$= \frac{52 - 13}{80 + 55} - \frac{016}{080}$
$= \frac{39}{135} - \frac{16}{180}$
$= \frac{13}{45} - \frac{8}{90}$
$= \frac{1}{5}$

45 100 yds weigh 14 08 lbs,

or $\frac{100}{100}$ m „ $\frac{14\ 08}{0\ 00\ 22}$ gm,

1 m „ $\frac{14\ 08\times 100}{0\ 00\ 22\times 100}$, or $\frac{128\times 109}{200}$, or 69 76 gm

46 Let x gallons of the first, and $(84-x)$ gallons of the second be taken

Water in first + water in second = water in mixture,

$$\frac{10x}{100}+\frac{3}{100}(84-x)=\frac{5}{100} \text{ of } 84, \text{ and } x=24,$$

req^{d} answer is 24 gallons of first, with 60 gallons of second

47 Since 24 hours = 86400 secs, and $2\frac{1}{4}$ min = 135 secs, the min hand moves over (86400 + 135), or 86535 sec spaces in 86400 actual secs,

it indicates 1 sec of time in $\frac{86400}{86535}$ actual secs,

„ 1 hr „ $\frac{86400}{86535}$ „ hrs

When it shews 5 p m on Wednesday, it has moved over

53 hour-spaces since noon on Monday,

correct time $=53\times\frac{86400}{86535}=53\times\frac{640}{641}$ hrs

This reduces to 52 hrs 55 min 2 secs after 12 noon on Monday, giving 4 hrs 55 min 2 secs after 12 noon on Wednesday

48 If profits are Rs x, since 40 % of Rs x is shared equally by them, we need only consider the remaining 60 % of Rs x, or Rs $\frac{3x}{5}$

This is divided in the ratio of 13500 7500, or 9 5,

their shares of this are $\frac{9}{14}$ of Rs $\frac{3x}{5}$, and $\frac{5}{14}$ of Rs $\frac{3x}{5}$ resp^{ly}

$$\frac{9}{14} \text{ of } \frac{3x}{5}=\frac{5}{14} \text{ of } \frac{3x}{5}+450, \text{ and } x=\text{Rs } 2625$$

I

49 Discount = Rs 9 8a on Rs 190, *i e* Rs $9\frac{1}{2}$ on Rs 190, or 5 %

50 Expenses $=\frac{37}{240}$ of £41647310 $=\frac{7}{48}$ of £41647310

= £6073566 = £6074000 (to nearest thousand)

For second part of question,

the old rateable value of £1 is now £1 $\times\frac{105}{100}$

The cost to collect £1 $\times\frac{105}{100}$ is now £$\frac{35}{240}\times\frac{110}{100}$,

„ £1 „ £$\frac{35}{240}\times\frac{110}{100}\times\frac{100}{105}$, or £$\frac{11}{72}$

This $=36\frac{2}{3}d$, giving 3*s* $0\frac{1}{2}d$

51 216 eggs are bought for $\frac{10}{12}\times 216$ annas, or 180 a
If x eggs are broken,
then $216-x$ are sold for $\frac{12}{10}\times(216-x)$ annas
Since a profit of 20 % is made, $\frac{12}{10}\times(216-x)=180\times\frac{120}{100}$,
$$216-x=\frac{180\times120\times10}{100\times12}, \text{ and } x=36$$

52 Let £P be the req^{d} sum, then from Art 313,
$$P=\frac{£800}{(1\cdot04)^4}=\frac{£800}{1\cdot16986}$$
$$=£683\,8=£684 \text{ to nearest £}$$

$$\begin{array}{r|l} & 6838 \\ \hline 1\,16986 & 800000 \\ & 698916 \\ & 10084 \\ & 6992 \\ & 1092 \\ & 699 \\ & 393 \end{array}$$

53 Space left uncovered is $(32\times25-29\frac{1}{2}\times22\frac{1}{2})$, or $136\frac{1}{4}$ sq ft
Since (32×25), or 800 sq ft cost £28 to cover,
$$\text{Amount saved}=£28\times\frac{136\frac{1}{4}}{800}=£4\,15\frac{3}{160}=£4\ 15s\ 4\tfrac{1}{2}d$$

54 A, B and C together fill $\frac{1}{8}$ of a cart in 1 min
A and C „ $\frac{1}{12}$ „ 1 „
A and B „ $\frac{1}{13\frac{1}{3}}$ „ 1 „
B fills $(\frac{1}{8}-\frac{1}{12})$, or $\frac{1}{24}$ of a cart in 1 min
C „ $\left(\frac{1}{8}-\frac{1}{13\frac{1}{3}}\right)$, or $\frac{1}{20}$ „ 1 „
A „ $(\frac{1}{12}-\frac{1}{20})$, or $\frac{1}{30}$ „ 1 „
Rs 7 8a should be divided in the proportion of $\frac{1}{30}$ $\frac{1}{24}$ $\frac{1}{20}$, or as 4 5 6, A getting Rs 2, B Rs 2 8a, C Rs 3

J

55 (i) $13s\ 3\frac{1}{2}d\times480=(13s\ 4d-\frac{1}{2}d)\times480=(£\frac{2}{3}-\frac{1}{480})\times480$
$=£320-£1=£319$

(ii) $24\times25\times26=6\times4\times25\times26=6\times100\times26=15600$

(iii) Income $=\frac{2\frac{3}{4}}{110}$ of Rs 12000 $=\frac{1}{40}$ of Rs 12000 $=$ Rs 300

(iv) The incomes are as $\frac{7\frac{1}{2}}{250}$ $\frac{11\frac{1}{4}}{400}$ Now $\frac{7\frac{1}{2}}{250}=\frac{15}{500}=\frac{3}{100}=\frac{12}{400}$,
shewing the first investment gives the larger income

56 7 men and 4 boys do $\frac{1}{2}$ the work of (14 men and 8 boys), or (14 men and 3 men), or 17 men in the same time,

7 men and 4 boys will take 4 times as long to do a piece of work twice as great,

$$\text{req}^{\text{d}}\ \text{time} = 17\ \text{days} \times \frac{3\ \text{men}}{17\ \text{men}} \times 4 = 12\ \text{days}$$

57 If £P be the Principal, the Interest $= £\frac{4P}{100}$,

$$\text{req}^{\text{d}}\ \text{time} = £P - £\frac{4P}{100}\ \text{yrs} = 25\ \text{years}$$

58 Let d feet be the req$^{\text{d}}$ depth, 100 gals $= \frac{100}{6\ 23}$ cu ft,

$9 \times d = \frac{100}{6\ 23}$, or $d = \frac{100}{5\ 6\ 07}$ ft $= \frac{1200}{5\ 6\ 07}$ in $= 1$ ft 9 in (nearly)

59 Let £x be price of 3 %, and let £2A be invested

The income from 1$^{\text{st}}$ stock is $£4 \times \frac{A}{90}$, from 2$^{\text{nd}}$ stock is $£3 \times \frac{A}{x}$,

and the total income is $£5 \times \frac{2A}{100}$, $\quad \frac{4A}{90} + \frac{3A}{x} = \frac{10A}{100}$

Divide by A, and

$$\frac{4}{90} + \frac{3}{x} = \frac{10}{100},\ \text{or}\ \frac{3}{x} = \frac{10}{100} - \frac{4}{90},\ \text{or}\ \frac{3}{x} = \frac{5}{90},\ \text{and}\ x = 54$$

60 B runs 7 5 mi per hr, or 1 mi in $\frac{60}{7\ 5}$, or 8 min,

in 6 min B runs $\frac{3}{4}$ mi, or 1320 yds

In 6 min A runs 1 mi $\times \frac{6}{7\ 1}$, or 1408 yds,

req$^{\text{d}}$ distance $= (1408 - 1320)$, or 88 yds

K.

61 Let x be req$^{\text{d}}$ number, in a year he sends $12x$ rupees, or $£12x \times \frac{10}{2\ 40}$,

$12x \times \frac{10}{2\ 40} = 100$, whence $x = 125$

62 Req$^{\text{d}}$ weight $= 7\ 207$ gm $\times 2\ 3 \times 2\ 3 \times 1000$

$= 5\ 29 \times 7\ 207$ Kg

$= 38$ Kg

7	207
	5 29
36	0
1	4
	6
38	0

63 The two kinds of eggs are worth 135 at ($2s\ 3d + 1s\ 9d$), or 135 at $4s$ a score $= 4s \times 6\frac{3}{4} = £1\ 7s$

220 lbs of lard at $8\frac{1}{4}d$ = 110 lbs of lard at $1s\ 4\frac{1}{2}d$ Combining this with the butter, we get 110 lbs at ($1s\ 4\frac{1}{2}d + 1s\ 7\frac{1}{2}d$), or 110 lbs at $3s$ a lb $= £16\ 10s$

106 cakes at $11s\ 3d$ a doz $= 318$ cakes at $3s\ 9d$ a doz

Combining these with the biscuits,

we get 318 articles at ($3s\ 9d + 4s\ 3d$) a doz,

or 318 at $8s$ a doz $= 318 \times \frac{8}{12}s = \frac{2}{3}\ 318s = £10\ 12s$

Total $= £1\ 7s + £16\ 10s + £10\ 12s = £28\ 9s$

Discount $= 10d \times 28\frac{9}{20} = (280 + 4\frac{1}{2})d = £1\ 3s\ 4\frac{1}{2}d$,

giving $£28\ 9s - £1\ 3s\ 4\frac{1}{2}d$, or $£27\ 5s\ 3\frac{1}{2}d$ for the discounted bill

64 Suppose I hold Rs x in the 3 per cents and Rs $(7200 - x)$ in the 5 per cents, the incomes from these are Rs $3 \times \frac{x}{100}$, and Rs $5 \times \frac{7200 - x}{100}$ Since the total income $=$ Rs $3\frac{1}{3} \times \frac{7200}{100}$,

$\frac{3x}{100} + \frac{5(7200 - x)}{100} = \frac{3\frac{1}{3} \times 7200}{100}$, or $3x + 5(7200 - x) = 3\frac{1}{3} \times 7200$,

and $x = 6000$

I hold Rs 6000 at 3 %, and Rs 1200 at 5 %

65 In the mixture of 9 gallons,

alcohol $= (\frac{25}{100}$ of $3 + \frac{75}{100}$ of $5)$ gals $= 4\frac{1}{2}$ gals, giving 50 %

66 Let his wages be x rupees per week His weekly savings $= x \times \frac{12\frac{1}{2}}{100}$ rupees, and his weekly expenses $= x \times \frac{87\frac{1}{2}}{100}$ rupees,

his increased weekly expenses $= x \times \frac{87\frac{1}{2}}{100} \times \frac{110}{100}$ rupees

Since his increased weekly wage is $(x + 1\frac{1}{2})$ rupees,

he saves $\left(x + 1\frac{1}{2} - x \times \frac{87\frac{1}{2}}{100} \times \frac{110}{100}\right)$ rupees per week

$$52\left(x + 1\tfrac{1}{2} - \frac{87\frac{1}{2}x}{100} \times \frac{110}{100}\right) = 52x \times \frac{12\frac{1}{2}}{100} - 13$$

Divide by 52, and $x + 1\frac{1}{2} - \frac{87\frac{1}{2}x}{100} \times \frac{110}{100} = \frac{12\frac{1}{2}x}{100} - \frac{1}{4}$,

giving $x + \frac{3}{2} - \frac{77x}{80} = \frac{x}{8} - \frac{1}{4}$ Multiply by 80, and we get $80x + 120 - 77x = 10x - 20$, whence $x = 20$

L

67 (i) Exp^n $=\frac{15\frac{3}{4}-8\frac{5}{6}}{4\frac{3}{5}+2\frac{10}{16}}=1$ (ii) Exp^n $=\frac{\frac{3}{70}+\frac{1}{33}}{9-\frac{3}{70}\times\frac{1}{33}}=\frac{\frac{169}{70\times33}}{\frac{6929}{770}}=\frac{1}{123}$

68 (i) Req^d speed $=2$ mi $\times\frac{60 \text{ min}}{40 \text{ min}}=3$ mi per hour

(ii) Req^d speed $=3$ mi in 1 hr $=(3\times1760\times3)$ ft in (60×60) secs $=\frac{3\times1760\times3}{60\times60}$ ft, or 4 4 in 1 sec

After going half a mile, 30 min remain in which he must walk $2\frac{1}{2}$ mi he must walk 5 mi in 60 min, or 1 hour

69 Let the watch cost Rs x, he sells it for Rs $x\times\frac{109\frac{1}{4}}{100}$, but this is the same as Rs $115\times\frac{97}{100}$ $x\times\frac{109\frac{1}{4}}{100}=115\times\frac{97}{100}$, and $x=100$

70 Let P_{10} be the population 10 years ago, P the population to day, then $P=P_{10}\times\frac{110}{100}$ Also $P=22000000\times\frac{105}{100}=23100000$,
$P_{10}\times\frac{110}{100}=23100000$ and $P_{10}=23100000\times\frac{100}{110}=21000000$
Req^d increase $=P-P_{10}=23100000-21000000=2100000$

71 4 qts weigh 10 lbs, 1 qt weighs 2 5 lbs, and 1 lit weighs 1 Kg, or 2 205 lbs

$$\frac{1 \text{ qt}}{1 \text{ lit}}=\frac{2\,5 \text{ lbs}}{2\,205 \text{ lbs}}=\frac{2500}{2205}=\frac{500}{441}=\frac{10}{8\,8} \text{ (nearly)},$$

and 8 8 qts $=10$ lit

If y quarts are equivalent to x litres, then $\frac{y}{x}=\frac{8\,8}{10}$ or $y=\frac{8\,8}{10}x$

Take 0 5″ to 1 litre horizontally, and 1″ to 1 quart vertically As in Art 277, Example, if we join the origin to the point (10, 8 8), the graph is obtained and the required values may be read off

72 Total cost $=6441000$ fl $=£\frac{6441}{1\,\cdot\,11}\times1000$
$=£531\,8\times1000=£532000$ (nearly)

Since 110 Km $=110\times\frac{5}{8}$ Km,

cost per mile $=£532000\times\frac{8}{5\times110}=£\frac{532\times8}{5\times110}\times1000$
$=£\frac{4256}{55}\times1000=£77\times1000$
$=£8000$ (nearly)

$$\begin{array}{r} 531\,8 \\ 1211\,)\,644100 \\ \underline{3860} \\ 2270 \\ \underline{2178} \\ 1060 \end{array}$$

M

73 Req^{d} int $= \text{Rs } 8740 \times \frac{220}{365} \times \frac{45}{100}$

$= \text{Rs } 8740 \times \frac{440}{730} \times \frac{45}{100}$

$= \text{Rs } \frac{1730529}{73}$

$= \text{Rs } 237\ 057 = \text{Rs } 237\ 1a$

$73)17305\,2(237\,057$
270
515
420
550
39

74 Let him hold £x stock, his income (after deduction of income tax) is $\frac{x \times 2\frac{1}{2}}{100} \times \frac{19}{20}$, $\frac{x \times 2\frac{1}{2} \times 19}{100 \times 20} = 539\frac{12}{20}$,

or $\frac{19 \times x}{20 \times 40} = \frac{10792}{20}$, and $x = \frac{10792 \times 40}{19} = £22720$

75 Area of larger $= 10 \times 1\ 01 \times 1\ 01$ ac $= 10\ 201$ ac.
diff of area $= 0\ 201$ ac $= 972$ sq yds 7 56 sq ft

484
$2\ 01$
968
$4\ 84$
$972\ 84$ sq yds
9
$7\ 56$ sq ft

76 1 sq mi, or 640 ac $= 625$ sq in, or 30 ac $= \frac{625 \times 3}{64}$ sq in,
req^{d} length of side $= \sqrt{\frac{625 \times 3}{64}}$ in $= \frac{25}{8} \times \sqrt{3}$ in $= \frac{25}{8} \times 1\ 73205$ in
$= \frac{43\ 301}{8}$ in $= 5\ 41$ in (nearly)

77 Let x rupees be prime cost, then, as in Art 293,
$x \times \frac{120}{100} \times \frac{125}{100} \times \frac{140}{100} = 131\frac{1}{8}$, and $x = \frac{105 \times 100 \times 100 \times 100}{8 \times 120 \times 125 \times 140} = 6\frac{1}{4}$

78 Net profits + balance − £5000 = £26613 8s 6d
Thus £26613 8s 6d is paid on a capital of £500000,
or £$\frac{26613\ 8s\ 6d}{5000}$ " " " £100
This gives a dividend of 5 %, and the remainder, £1613 8s 6d, is carried forward

N

79 1 cm per 1 sec $= 19\ 8$ Km per 1980000 secs
Now 1980000 secs $= \frac{1980000}{60 \times 24 \times 365}$ yrs $= \frac{19800}{5256}$ yrs
$= 3\ 8$ yrs

$525,6)19800(3\ 76$
4032
353

80 Let req^{d} price be x francs

Then $x \times 100 = (2\cdot75 \times 80 + 9\cdot5 \times 20) \times \frac{110}{100}$

$= (220 + 190) \times \frac{110}{100}$,

$x = \frac{410 \times 110}{100 \times 100} = 4\cdot51$ fr

81 The internal volume of the box is $(17-2)^3$, or 15^3 cu in,

15^3 cu in would contain ore worth £$421\frac{7}{8}$, or £$\frac{15^3}{2^3}$,

hence 2^3 cu in " " " £1

But the ore in the box is actually worth £$(421\frac{7}{8} - 78\frac{7}{8})$, or £$7^3$,

the internal volume of the box must be $2^3 \times 7^3$ cu in,

or 14^3 cu in,

and the thickness of the material $= \frac{1}{2}(17-14)$ in, or $1\frac{1}{2}$ in

82 Re 1 per day = Rs 365 per annum,

req^{d} percentage $= 100 \times \frac{10}{1000} = \frac{307}{101} = 3\cdot02$

83 The second cyclist rides 1760 yds in 200 secs,

" " $1760 \times \frac{195}{200}$, or 1716 yds in 195 secs

But the first rides 1760 yds in 195 secs,

req^{l} start $= (1760 - 1716)$ yds $= 44$ yds

84 Diff of the two interests = interest on first year's interest,

Rs 115 5a. − Rs 112 8a, or Rs $2\frac{1}{10}$ is interest on Rs 112 8a,

Rs $2\frac{1}{10} \times \frac{100}{112\frac{1}{2}}$, or Rs $2\frac{2}{9}$ " " Rs 100

Thus req^{d} rate $= 2\frac{2}{9}$ %, and req^{d} Principal = Rs $112\frac{1}{2} \times \frac{100}{2\frac{2}{9}}$ = Rs 4500

O

85 £11 18s 1d = £12 − 1s 8d = £12 − $\frac{1}{12}$ of £1

£2 12s 6d = £3 − 7s 6d = £3 − $\frac{1}{8}$ of £3

86 As in Art 302, Ex 2, we have

$P + P \times \frac{2\frac{1}{2}}{100} \times \frac{63}{365} = 4518\cdot5625$,

$P\left(1 + \frac{9 \times 63}{100 \times 365}\right) = 4548\cdot5625$,

or $P \times \frac{146567}{146000} = 4518\cdot5625$,

$P = 4548\cdot5625 \times \frac{146000}{146567}$

	4548562 5
	146
	45485625
	181942500
	27291375 0
146567	664090125 0 (4530 9
	77822
	1538
	141
	10

87 $(\frac{5}{8})^3$ cu in weigh 0 625 lb or $\frac{5}{8}$ lb

$(\frac{5}{8})^2$ weighs 1 lb

$(\frac{5}{8})^2 \times 40$, or $\frac{5^3}{2^3}$ cu in weigh 40 lbs

length of edge $= \frac{5}{2}$ in $= 2\frac{1}{2}$ in

88 The engine must run a number of feet equal to the L C M of 135 ft, 275 ft, and 1320 ft ($\frac{1}{4}$ mile)

This L C M $= 2^3\ 3^3\ 5^2\ 11$ ft $= \frac{2^3\ 3^3\ 5^2\ 11}{1760\ 3}$ mi

$= \frac{2^3\ 3^3\ 5^2\ 11}{2^5\ 5\ 11\ 3}$ mi $= 11\frac{1}{4}$ mi

89 The first kind costs him $\frac{100}{125}$ of 20 a, or 16 a per lb,

the second " " $\frac{100}{112\frac{1}{2}}$ of 27 a, or 24 a per lb

Selling at 23 a per lb, his gain on a mixture of 2 lbs is

46 a $-(16+24)$ a, or 6 a

on an outlay of 40 a he will gain 6 a, giving 15 %

90 His income $= \frac{3}{100}$ of £19250 $=$ £577$\frac{1}{2}$

An increase of 10 % on this $=$ £57$\frac{1}{2}$

Each £100 stock sold realises £99 cash

This buys stock at 104 and brings in

an income of £4 $\times \frac{99}{104}$, or £$\frac{99}{26}$

increase of income per £100 stock sold $=$ £$\frac{99}{26}$ $-$ £3 $=$ £$\frac{21}{26}$

Hence an increase of £57$\frac{1}{2}$ in the income requires the sale of

£100 $\times \frac{26}{21} \times 57\frac{1}{2}$, or £7150 stock

91 Suppose y ac. are reaped by x men Then, as in Art 277, Ex, $y = \frac{21}{4}x$ Taking scales of 0 1" to 1 ac. horizontally, and 0 1" to 1 man vertically, if we join the origin to the point (24, 29), we obtain a graph from which we can read off the required values

92 Let req^d cost be x shillings Then, from Art 293, we have

$x \times \frac{120}{100} \times \frac{105}{100} = 70$, $\quad x = \frac{70 \times 100 \times 100}{120 \times 105} = \frac{500}{9} = 55\frac{5}{9}$

req^d cost $=$ Rs 56

P

93 Req^{d} interest $= \text{Rs } \frac{27}{100} \times \frac{68}{365} \times 2378$

$= \text{Rs } \frac{18 \cdot 36 \times 2378}{100 \times 365}$

$= \text{Rs } 12\ 183$

$= \text{Rs } 12\ 3a$

23 78
187
2378
19024
166 46
365) 1146 86 (12 183
796
668
3036
116
6

94 36 m cost 59d, or £$\frac{59}{240}$

$\frac{36}{59 \cdot 17}$ m cost $\frac{59}{240} \times 25 \cdot 2$ fr,

and 1 m cost $\frac{59 \times 252 \times 39 \cdot 37}{240 \times 36}$ fr,

or 1 m cost $\frac{59 \cdot 07 \times 39 \cdot 37}{24}$ fr,

or 6 77 ft

$\frac{59 \cdot 07 \times 39 \cdot 37}{24}$

$= \frac{4\ 13 \times 39 \cdot 37}{24}$

$= \frac{162 \cdot 3981}{24}$

$= \frac{20 \cdot 3247}{3} = 6\ 774$

95 1000 gals $= 1000 \times 0 \cdot 16$ cu ft $= 160$ cu ft,

$160 \times 60 \times 24$ cu ft are discharged in a day

If x is req^{d} no of days, then $160 \times 60 \times 24 \times x = 300 \times 300 \times 20$,

and $x = 7\frac{1}{2}$

96 The outlay on 120 eggs $= \text{Rs } 3\ 12a + \text{Re } 1\ 4a = \text{Rs } 5$ Since 20 are broken, the selling price of 100 must be Rs 5 + Re 1 14a, i.e. Rs 6 11a, or 110a Measure 10 inches to the inch horizontally, and 10 eggs to the inch vertically The equation of the graph will be $\frac{y}{100} = \frac{x}{110}$, or $y = \frac{10}{11}x$ Join the point (11, 10) to the origin, and from this graph read off the required values

97 32 sq yds 1 sq ft $= 289$ sq ft $= 17^2$ sq ft, length $= 17$ ft

area to be painted

$= (17 \times 11\frac{1}{2} \times 4 + 17 \times 17 - 7\frac{1}{2} \times 3\frac{1}{2} - 5\frac{1}{2} \times 3\frac{1}{2})$ sq ft

$= (17 \times 46 + 17 \times 17 - 25 - 20)$ sq ft $= 1026$ sq ft

Hence cost $= \frac{11}{9}a \times 1026 = \frac{17}{2} \times 57a = \text{Rs } 30\ 4a\ 6p$

98 Let £x be req^{d} gross income Then net income $= x \times \frac{87}{100} \times \frac{231}{240}$

Now £513 16s 6d = £513$\frac{13}{20}$ = £$\frac{10273}{20}$—

$x \times \frac{87}{100} \times \frac{231}{240} = \frac{10273}{20}$, $\quad x = \frac{10273 \times 100 \times 240}{20 \times 87 \times 231} = £620$

99 Let V cu cm be the volume of each pellet,
then $58\,V = 2^2 \times 1 \times 0\,7854$,

$$V = \frac{4 \times 0\,7854}{58} = \frac{1\,5708}{29} - 5\,416 = 54\,2 \text{ cu mm}$$

100 Let L cwt be the load when AP $= x$ ft (BP $= (10 - x)$ ft)

Then, from Art 283, $L = \dfrac{k}{x(10-x)}$ When $x = 5$, $L = 12$,

and we find $k = 300$, $\quad L = \dfrac{300}{x(10-x)}$

To find the req^{d} loads, we put $x = 1$ ft, 2 ft, 3 ft, 4 ft successively, and find $L = 33\frac{1}{3}$ cwt, $18\frac{3}{4}$ cwt, $14\frac{2}{7}$ cwt, $12\frac{1}{2}$ cwt respectively

EXAMPLES XX a Page 411

1 Fract$^{n} = \dfrac{1}{2 + \frac{1}{3}}$ 2 Fract$^{n} = \dfrac{3}{1 + \frac{1}{3\frac{1}{2}}}$ 3 Exp$^{n} = 2 + \dfrac{4}{1 + \frac{1}{3}}$

4 Exp$^{n} = 3 - \dfrac{1}{2 + \frac{1}{4}}$ 5 Fract$^{n} = \dfrac{6}{2 + \frac{1}{1\frac{1}{3}}}$ 6 Fract$^{n} = \dfrac{10}{1 + \frac{3}{2}}$

7 Exp$^{n} = 7 - \dfrac{2}{8 - \frac{1}{7}}$ 8 Fract$^{n} = \dfrac{11}{3 + \frac{5}{1\frac{1}{3}}}$ 9 Exp$^{n} = 5 - \dfrac{2}{4 - \frac{1}{4}}$

10 Fract$^{n} = \dfrac{2 + \frac{5}{7}}{6 + \frac{7}{9\frac{1}{8}}}$ 11 Fract$^{n} = \dfrac{6 + \frac{6}{3\frac{1}{5}}}{4 - \frac{4}{1\frac{1}{5}}} \times 10\frac{8}{9}$ 12 Fract$^{n} = \dfrac{2 + \frac{5}{1\frac{1}{6}}}{2 + \frac{1}{3\frac{4}{5}}}$

13 Exp$^{n} = 2 - \dfrac{3}{9 - \frac{7}{1\frac{8}{13}}} = 2 - \dfrac{3}{4\frac{2}{3}}$ 14 Exp$^{n} = 2 - \dfrac{2}{8 - \frac{7}{1\frac{9}{19}}} = 2 - \dfrac{2}{3\frac{1}{4}}$

EXAMPLES XX b Page 415

1 The first two convergents are $\frac{2}{1}$ and $\frac{7}{3}$ 3rd convergent $= \frac{7 \times 1 + 2}{3 \times 1 + 1} = \frac{9}{4}$,
4th convergent $= \frac{9 \times 2 + 7}{4 \times 2 + 3} = \frac{25}{11}$, 5th convergent $= \frac{25 \times 5 + 9}{11 \times 5 + 4} = \frac{134}{59}$

2 The first two convergents are $\frac{3}{1}$ and $\frac{13}{4}$ The others are
$\frac{13 \times 2 + 3}{4 \times 2 + 1}$, $\frac{29 \times 1 + 13}{9 \times 1 + 4}$, $\frac{42 \times 3 + 29}{13 \times 3 + 9}$, $\frac{155 \times 5 + 42}{48 \times 5 + 13}$

3 The first two convergents are $\frac{1}{2}$ and $\frac{2}{5}$ The others are
$\frac{2 \times 3 + 1}{5 \times 3 + 2}$, $\frac{7 \times 1 + 2}{17 \times 1 + 5}$, $\frac{9 \times 4 + 7}{22 \times 4 + 17}$, $\frac{43 \times 2 + 9}{105 \times 2 + 22}$, $\frac{9 \times 6 + 43}{232 \times 6 + 105}$

4 As in Art 336, we have

1	79	291	3
6	25	54	2
	1	4	4

This gives $\frac{1}{3+}\ \frac{1}{1+}\ \frac{1}{2+}\ \frac{1}{6+}\ \frac{1}{4}$

The first two converg^{ts} are $\frac{1}{3}$ and $\frac{1}{4}$,

the 3rd and 4th are $\frac{1\times2-1}{4\times2+3}$, $\frac{3\times6+1}{11\times6+4}$

5 As in Art 336, we have

2	97	625	6
1	11	43	3
	1	10	10

This gives $\frac{1}{6+}\ \frac{1}{2+}\ \frac{1}{3+}\ \frac{1}{1+}\ \frac{1}{10}$

The first two converg^{ts} are $\frac{1}{6}$ and $\frac{2}{13}$

the 3rd and 4th are $\frac{2\times3+1}{13\times3+6}$, $\frac{7\times1+2}{45\times1+13}$

6 As in Art 336, we have

2	233	313	1
10	73	80	1
3	3	7	2
		1	

This gives $1+\frac{1}{2+}\ \frac{1}{1+}\ \frac{1}{10+}\ \frac{1}{2+}\ \frac{1}{3}$

The first two converg^{ts} are $\frac{1}{1}$ and $\frac{3}{2}$,

the 3rd and 4th are $\frac{3\times1+1}{2\times1+1}$, $\frac{4\times10+3}{3\times10+2}$

7 As in Art 336, we have

4	349	1128	3
4	25	81	3
	1	6	6

This gives $3+\frac{1}{4+}\ \frac{1}{3+}\ \frac{1}{4+}\ \frac{1}{6}$

The first two converg^{ts} are $\frac{3}{1}$ and $\frac{13}{4}$,

the 3rd and 4th are $\frac{13\times3+3}{4\times3+1}$, $\frac{42\times4+13}{13\times4+4}$

8 As in Art 336, we have

7	1000	1139	1
6	27	139	5
3	3	4	1
		1	

This gives $1+\frac{1}{7+}\ \frac{1}{5+}\ \frac{1}{6+}\ \frac{1}{1+}\ \frac{1}{3}$

The first two converg^{ts} are $\frac{1}{1}$ and $\frac{8}{7}$,

the 3rd and 4th are $\frac{8\times5+1}{7\times5+1}$, $\frac{41\times6+8}{36\times6+7}$

9 As in Art 336, we have

2	1000	1414	1
2	172	414	2
5	32	70	2
	2	6	3

This gives $1+\frac{1}{2+}\ \frac{1}{2+}\ \frac{1}{2+}\ \frac{1}{2+}\ \frac{1}{5+}\ \frac{1}{3}$

The first two converg^{ts} are $\frac{1}{1}$ and $\frac{3}{2}$,

the 3rd and 4th are $\frac{3\times2+1}{2\times2+1}$, $\frac{7\times2+3}{5\times2+2}$

10 As in Art 336, we have

1	393	1000	2
5	179	214	1
1	4	35	8
	1	3	3

This gives $\frac{1}{2+}\ \frac{1}{1+}\ \frac{1}{1+}\ \frac{1}{5+}\ \frac{1}{8+}\ \frac{1}{1+}\ \frac{1}{3}$

The first two converg^{ts} are $\frac{1}{2}$ and $\frac{1}{3}$,

the 3rd and 4th are $\frac{1\times1+1}{3\times1+2}$, $\frac{2\times5+1}{5\times5+3}$

11 As in Art 336, we have

3	3029	10000	3
6	290	913	3
2	32	43	1
10	10	11	1
		1	

This gives $\frac{1}{3+}\ \frac{1}{3+}\ \frac{1}{3+}\ \frac{1}{6+}\ \frac{1}{1+}\ \frac{1}{2+}\ \frac{1}{1+}\ \frac{1}{10}$

The first two converg^{ts} are $\frac{1}{3}$ and $\frac{7}{10}$,

the 3rd and 4th are $\frac{3\times3+1}{10\times3+3}$, $\frac{10\times6+7}{33\times6+10}$

12 See Art 339, Ex 2, and Art 340

The 4th and 5th Converg^{ts} are $\frac{9}{22}$ and $\frac{43}{105}$

the error in taking $\frac{43}{105}$ for the C F is less than $\frac{1}{2\times105\times22}$, or $\frac{1}{1020}$

13 1 metre=39 37 in =1 0936 yds Express this as a C F

We obtain $\frac{35}{32}$ for the 4th Converg^{t}

1 metre=$\frac{35}{32}$ yds (nearly), or 32 metres=35 yds (nearly)

14 One div^{n} of the first=$\frac{200}{102}$ div^{ns} of the second

Expressing this as a C F, we obtain $\frac{40}{31}$ as the 4th Converg^{t}

one div^{n} of the first=$\frac{40}{31}$ div^{ns} of the second (nearly),

or 31 div^{ns} of the first=40 div^{ns} of the second (nearly)

15 See Art 339, Ex 2, and Art 340 The 6th and 7th Converg^{ts} of 1 41421 are $\frac{99}{70}$ and $\frac{239}{169}$ Of these, $\frac{99}{70}$ is greater, and $\frac{239}{169}$ is less, than the C F Since, then, the C F lies between them in value, it follows that the difference of $\frac{99}{70}$ and the C F is less than $\frac{99}{70}-\frac{239}{169}$, or $\frac{1}{70\times169}$

16 See Art 339, Ex 2, and Art 340

The 4th and 5th Converg^{ts} are $\frac{21}{10}$ and $\frac{151}{115}$

the C F differs from $\frac{151}{115}$ by less than $\frac{1}{2\times16\times115}$, or $\frac{1}{3680}$

Thus $\frac{151}{115}$ is the req^{d} approximation

17 The C F $=3+\frac{1}{3+}\frac{1}{1+}\frac{1}{2+}\frac{1}{9+}\frac{1}{4}=\frac{1\cdot 84}{4\cdot 3}$

The 4th and 5th Convergts are $\frac{36}{11}$ and $\frac{133}{10\cdot 3}$ Since the C F lies between these in value, it follows that the C F differs from $\frac{36}{11}$ by less than $\frac{36}{11}-\frac{133}{10\cdot 3}$, or $\frac{1}{11\times 103}$, which is less than 0 001

Now $\frac{133}{10\cdot 3}$ is nearer the C F in value than $\frac{36}{11}$
the error in this case is also less than 0 001

19 1 fr $=\frac{60}{2\cdot 5\cdot 0}s=\frac{50}{4\cdot 3}s$

The 3rd and 4th convergts of $\frac{50}{43}$ are $\frac{4}{5}$ and $\frac{93}{120}$

As in No 17 it may be shewn that 1 fr differs from $\frac{4}{5}s$,
or from $\frac{93}{120}s$ by a quantity less than $\frac{1}{120\times 2}s$, or $\frac{1}{145}s$,
for 145 fr the diff is less than 1s

20 $\sqrt{26}$ lies between 5 and 6 Put $\sqrt{26}=5+r$

$$(5+r)=26, \text{ or } 10r+r^2=1$$

$$r=\frac{1}{10+r}=\frac{1}{10+}\ \frac{1}{10+}\ \frac{1}{10+}$$

The 3rd and 4th convergts are $\frac{1}{10}\ \frac{10}{101}$ and $\frac{1}{10}\ \frac{10}{101}\ \frac{1}{5}$

From Art 310, it follows that $\frac{1}{10}\ \frac{10}{101}$ differs from $\sqrt{26}$
by a fraction less than $\frac{1}{5\times 10\cdot 5\times 10301}$ or $\frac{1}{5040\times 10301}$

21 Consider the decimal portion 0 242218 It reduces to a C F whose first and third convergents are $\frac{1}{4}$ and $\frac{8}{33}$, thus shewing 8 days in 33 years to be more correct than 1 day in 4 yrs

Now 8 days in 33 yrs $=0\ 242424$ day in 1 yr
error for 1 yr $=(0\ 242424-0\ 242218)$ day $=0\ 000206$ day
1 day would be the error for $\frac{1}{0\ 000\cdot 206}$ yrs, or 4854 yrs

EXAMPLES XX c Page 418

1 (i)

	2753
	31
	8259
$\frac{1}{4}$	393 29
	8652 29
Subt $\frac{1}{10000}$	3 16
	8648 83
	i e 8649

(ii)

	327
	16 8
	549 36
	31
	1648 08
$\frac{1}{4}$	78 48
	1726 56
Subt $\frac{4}{10000}$	69
	1725 87
	i e 1726

2 Req^{d} area $=(62\cdot3)^2\times\pi$
$=3881\cdot29\times\pi$
$=12193\cdot46$ sq m

	3881 29
	π
	11613 87
$\frac{1}{7}$	551 17
	12198 34
Subt $\frac{1}{700}$	4 88
	12193 46

3 (i) $3\cdot14159625\overline{)1\cdot000000000}\ 0\cdot31830989$

57522205
26106278
973537
31059
2785
272

N B From Art 313,
$\pi=3\cdot14159265$

(ii) $\frac{1}{3}-(\frac{1}{100}+\frac{1}{200}+\frac{1}{70000})$
$=0\cdot3333-(0\cdot01+0\cdot005+0\cdot00002)$
$=0\cdot31831$

(iii) Req^{d} diameter
$=291\cdot85$ m $\times\frac{1}{\pi}$
$=291\cdot85\times0\cdot3183$ m
$=93$ m (nearly)

291	85
	0 3183
87	3
2	9
2	3
	1
92	9

4 (i)

	m
	3724
$\frac{1}{12}$	310 3
$\frac{1}{80}$	38 8
	4073 1

giving 1073 yds

(ii)

	m
	561 41
$\frac{1}{12}$	46 76
$\frac{1}{96}$	5 85
	614 01

giving 614 yds

5 It may be easily shown that $1-\frac{1}{10}+\frac{1}{10}=\frac{7}{8}$

(i)

	yds
	3650
Subtract $\frac{1}{10}$	365
	3285
Add $\frac{1}{80}$	52 14
	3337 1

giving 3337 *m*

(ii)

	yds
	8800 (=5 miles)
Subtract $\frac{1}{10}$	880
	7920
Add $\frac{1}{80}$	125 71
	8045 71

giving 8046 *m*

6 22 yds $=20$ m,
1760 yds $=1600$ m
But 1760 yds $=1760\times0\cdot91439$ m
$=1609\cdot3$ m
Error $=(1609\cdot3-1600)$ m $=9\cdot3$ m

911	39
	1 76
911	39
640	07
51	86
1609	32

For second part of question, we have

1 mile = 80 chains = $80\left(20+\frac{1}{10}+\frac{1}{70}\right)$ m = (1600+8+1) m = 1609 m

7 (i) 5 ft 3 in = 63 in req^{d} equivalent = $63\left(\frac{10}{4}+\frac{4}{100}\right)$ cm
= (157 5+2 52) cm = 1 60 m ,

(ii) req^{d} equi^{t} = $39\ 375\left(\frac{10}{4}+\frac{4}{100}\right)$ cm = (98 44+1 57) cm = 1 00 m

8

	1 4
Add $\frac{1}{100}$	014
Add $\frac{1}{10000}$	00014
Add $\frac{1}{200000}$	00007
	1 41421
	$=\sqrt{2}$

	353 55
	1 4
	353 55
	141 42
	494 97
Add $\frac{1}{100}$	4 95
Add $\frac{1}{10000}$	05
Add $\frac{1}{200000}$	00
	499 97
	= 500 m

9 (i)

$\frac{1}{5}$	= 0 20000	00
$\frac{1}{5^2}$	= 0 04000	00
$\frac{1}{5^3}$	= 0 00800	00
$\frac{1}{5^4}$	= 0 00160	00
$\frac{1}{5^5}$	= 0 00032	00
$\frac{1}{5^6}$	= 0 00006	40
$\frac{1}{5^7}$	= 0 00001	28
$\frac{1}{5^8}$	= 0 00000	26
$\frac{1}{5^9}$	= 0 00000	05
$\frac{1}{5^{10}}$	= 0 00000	00
	0 25000	00

(ii)

$\frac{1}{7}$	= 0 14285	71
$\frac{1}{7^2}$	= 0 02040	82
$\frac{1}{7^3}$	= 0 00291	55
$\frac{1}{7^4}$	= 0 00041	65
$\frac{1}{7^5}$	= 0 00005	95
$\frac{1}{7^6}$	= 0 00000	85
$\frac{1}{7^7}$	= 0 00000	12
$\frac{1}{7^8}$	= 0 00000	02
$\frac{1}{7^9}$	= 0 00000	00
	0 16666	67

giving 0 166667

10.

$$\frac{1}{2} = 0\,500000 \mid 00$$

$$\frac{1}{2\ 4} = 0\,125000 \mid 00$$

$$\frac{1}{2\ 1\ 6} = 0\,020833 \mid 33$$

$$\frac{1}{2\ 4\ 6\ 8} = 0\,002604 \mid 17$$

$$\frac{1}{2\ 4\ 6\ 8\ 10} = 0\,000260 \mid 42$$

$$\frac{1}{2\ 4\ 6\ 8\ 10\ 12} = 0\,000021 \mid 70$$

$$\frac{1}{2\ 4\ 6\ 8\ 10\ 12\ 11} = 0\,000001 \mid 55$$

$$\frac{1}{2\ 4\ 6\ 8\ 10\ 12\ 11\ 16} = 0\,000000 \mid 10$$

$$\frac{1}{2\ 4\ 6\ 8\ 10\ 12\ 14\ 16\ 18} = 0\,000000 \mid 00$$

$$0\,618721 \mid 27$$

giving 0 648721

11 $\frac{1}{1\ 3} = 0\,333333 \mid 33$

$\frac{1}{3\ 3^3} = 0\,33333333 - (3 \times 9) - 0\,11111111 - 9 = 0\,012345 \mid 67$

$\frac{1}{5\ 3^5} = 0\,01234567 - (3 \times 5) = 0\,00411522 - 5 = 0\,000823 \mid 01$

$\frac{1}{7\ 3^7} = 0\,00411522 - (9 \times 7) = 0\,00015725 - 7 = 0\,000065 \mid 32$

$\frac{1}{9\ 3^9} = 0\,00015725 - (9 \times 9) = 0\,00005081 - 9 = 0\,000005 \mid 65$

$\frac{1}{11\ 3^{11}} = 0\,00000565 - 11 = 0\,000000 \mid 51$

$\frac{1}{13\ 3^{13}} = 0\,00000565 - (9 \times 13) = 0\,00000063 - 13 = 0\,000000 \mid 05$

$0\,316573 \mid 57$

giving 0 316574

EXAMPLES XXI b Page 425

9 $\log \frac{a}{bc} = \log a - \log (bc) = \log a - \log b - \log c$

10 $\log \frac{a^2}{bc^3} = \log a^2 - \log (bc^3) = \log a^2 - \log b - \log c^3$
$= 2 \log a - \log b - 3 \log c$

11 $\log \frac{a^{\frac{1}{2}} b^{\frac{2}{3}}}{c^5} = \log \left(a^{\frac{1}{2}} b^{\frac{2}{3}}\right) - \log c^5 = \log a^{\frac{1}{2}} + \log b^{\frac{2}{3}} - \log c^5$
$= \frac{1}{2} \log a + \frac{2}{3} \log b - 5 \log c$

12 $\log \frac{\sqrt[4]{b}\ \sqrt[3]{c}}{\sqrt{a^3}} = \log \frac{b^{\frac{1}{4}} c^{\frac{1}{3}}}{a^{\frac{3}{2}}} = \log \left(b^{\frac{1}{4}} c^{\frac{1}{3}}\right) - \log a^{\frac{3}{2}} = \log b^{\frac{1}{4}} + \log c^{\frac{1}{3}} - \log a^{\frac{3}{2}}$
$= \frac{1}{4} \log b + \frac{1}{3} \log c - \frac{3}{2} \log a$

13 $\log 36 = \log (2^2\ 3^2) = \log 2^2 + \log 3^2 = 2 \log 2 + 2 \log 3$

14 $\log \frac{1}{108} = \log \frac{1}{2^2\ 3^3} = \log 1 - \log (2^2\ 3^3) = -2 \log 2 - 3 \log 3$

15 $\log \sqrt{648} = \log \sqrt{2^3\ 3^4} = \log \left(2^{\frac{3}{2}}\ 3^2\right) = \frac{3}{2} \log 2 + 2 \log 3$

16 $\log \sqrt{54} \times \sqrt[3]{243} = \log (\sqrt{2\ 3^3}\ \sqrt[3]{3^5}) = \log \left(2^{\frac{1}{2}}\ 3^{\frac{3}{2}}\ 3^{\frac{5}{3}}\right) = \log \left(2^{\frac{1}{2}}\ 3^{\frac{3}{2}+\frac{5}{3}}\right)$
$= \log \left(2^1\ 3^{\frac{19}{6}}\right) = \frac{1}{2} \log 2 + \frac{19}{6} \log 3$

17 $\log \left(\frac{2}{3} \frac{1}{8} - \frac{7}{6} \frac{1}{6}\right) = \log 49 = \log 7^2 = 2 \log 7$

18 $\log \frac{2}{5} \frac{6}{1} + \log \frac{11}{6} \frac{10}{1} = \log \left(\frac{2}{5} \frac{6}{1} \times \frac{11}{6} \frac{10}{1}\right) = \log \frac{2}{3} = \log 2 - \log 3$

19 We have $\log PR^n = \log A$, or $\log P + n \log R = \log A$,

$$n \log R = \log A - \log P, \text{ and } n = \frac{\log A - \log P}{\log R}$$

20 We have $\log \frac{\pi d^3}{6} = \log V$, or $\log \pi + 3 \log d - \log 6 = \log V$,

whence $\log d = \frac{1}{3} (\log V + \log 6 - \log \pi)$

EXAMPLES XXI c Page 429

4–11 See Art 368

12 $\bar{4}.5703 - 5 = \frac{(\bar{5}+1.5703)}{5} = \bar{1}.3141$

13 $\frac{1}{6}(\bar{3}.8123) = \frac{1}{6}(\bar{6}+3.8123) = \bar{1}.6354$

14 $\frac{2}{5}(\bar{1}.5632) = \frac{1}{5}(\bar{1}.1264) = \frac{1}{5}(\bar{5}+4.1264) = \bar{1}.8253$

15 $\frac{3}{4}(\bar{2}.1305) = \frac{1}{4}(\bar{6}.3915) = \frac{1}{4}(\bar{8}+2.3915) = \bar{2}.5979$

EXAMPLES XXI d Page 432

1

	log 283	$=\bar{1}.4518$	
diff for	4 =	6	
	log 17 6	$=1.2455$	antilog .698 $=4.989$
diff for	2 =	5	diff for 4 = 5
	log product =	6984	antilog .6984 $=4.994$

2

	log 8 03	= .9047	
diff for	4 =	2	
	log 189	$=\bar{1}.2765$	antilog .182 $=1.521$
diff for	3 =	7	diff for 1 = 0
	log product =	1821	antilog .1821 $=1.521$

3

	log 470	$=2.6721$	
diff for	8 =	7	antilog 3.478 $=3006$
	log 6 39	= .8055	diff for 3 = 2
	log product =	3.4783	antilog 3.4783 $=3008$

4

	log 3 7	= .5682	
	log 8 9	= .9494	antilog $\bar{1}.879$ = .7568
	log .023	$=\bar{2}.3617$	diff for 3 = 5
	log product =	$\bar{1}.8793$	antilog $\bar{1}.8793$ = .7573

5

	log 31 9	$=1.5038$	
	log 1 51	= .1790	antilog 2.669 $=466.7$
	log 9 7	= .9868	diff for 6 = 6
	log product =	2.6696	antilog 2.6696 $=467.3$

6

	log 43	$=1.6335$	
	log 8 07	= .9069	antilog .133 $=1.358$
	log .0392	$=\bar{2}.5933$	diff for 7 = 2
	log product =	.1337	antilog .1337 $=1.360$

	Numerator	Denominator
7	log 17 3 = 1 2380	log 294 0 = 2 4683
		diff for 8 = 12
	log numerator = 1 2380	log denominator = 2 4695
	1 2380	antilog $\bar{2}$ 768 = 05861
	subtract 2 4695	diff for 5 = 7
	log fraction = $\bar{2}$ 7685	antilog $\bar{2}$ 7685 = 05868

	Numerator	Denominator
8	log 487 = 2 6875	log 6390 = 3 8055
		diff for 8 = 5
	log numerator = 2 6875	log denominator = 3 8060
	2 6875	antilog $\bar{2}$ 881 = 07603
	subtract 3 8060	diff for 5 = 9
	log fraction = $\bar{2}$ 8815	antilog $\bar{2}$ 8815 = 07612

	Numerator	Denominator
9	log 2 17 = 3365	log 897 = $\bar{1}$ 9528
	diff for 9 = 18	diff for 3 = 1
	log numerator = 3383	log denominator = $\bar{1}$ 9529
	3383	antilog 385 = 2 427
	subtract $\bar{1}$ 9529	diff for 4 = 2
	log fraction = 0 3854	antilog 3854 = 2 429

	Numerator	Denominator
10	log 0125 = $\bar{2}$ 0969	log 410 = 0 6128
	diff for 4 = 14	diff for 5 = 5
	log numerator = $\bar{2}$ 0983	log denominator = 0 6133
	$\bar{2}$ 0983	
	subtract 0 6133	antilog $\bar{3}$ 4850 = 0 003055
	log fraction = $\bar{3}$ 4850	

	Numerator	Denominator
11	log 2 38 = 0 3766	log 4 83 = 0 6839
	log 3 90 = 0 5911	
	diff for 1 = 1	
	log numerator = 0 9678	log denominator = 0 6839
	0 9678	antilog 0 283 = 1 919
	subtract 0 6839	diff for 9 = 4
	log fraction = 0 2839	antilog 0 2839 = 1 923

12

Numerator		Denominator	
log 14 7	= 1 1673		
diff for 2	= 6		
log 38 0	= 1 5798	log 387	= 2 5877
diff for 5	= 6	diff for 9	= 10
log numerator	= 2 7483	log denominator	= 2 5887
	2 7483	antilog 0 159	= 1 442
subtract	2 5887	diff for 6	= 2
	0 1596	antilog 0 1596	= 1 444

13

Numerator		Denominator	
log 925	= 2 9661		
diff for 9	= 4		
log 1 59	= 0 2014	log 74 0	= 1 8692
diff for 7	= 20	diff for 3	= 2
log numerator	= 3 1699	log denominator	= 1 8694
	3 1699	antilog 1 300	= 19 95
subtract	1 8694	diff for 5	= 2
log fraction	= 1 3005	antilog 1 3005	= 19 97

14 Let $x = \sqrt{5\,1}$, or $(5\,1)^{\frac{1}{2}}$ Then $\log x = \frac{1}{2}\log 5\,1 = \frac{1}{2}(0\,7076)$
$= 0\,3538 = \log(2\,258)$

15 Let $x = \sqrt[3]{11}$, or $(11)^{\frac{1}{3}}$ Then $\log x = \frac{1}{3}\log 11 = \frac{1}{3}(1\,0414)$
$= 0\,3471 = \log(2\,224)$

16 Let $x = (0\,097)^4$ Then $\log x = 4\log(0\,097) = \bar{2}\,9868 \times 4$
$= \bar{5}\,9472 = \log(0\,00008855)$

17 Let $x = \sqrt[4]{10\,15}$, or $(10\,15)^{\frac{1}{4}}$ Then $\log x = \frac{1}{4}\log(10\,15)$
$= \frac{1}{4}(1\,0064) = 0\,2516 = \log 1\,784$

18 [153 76 = 153 8 correct to four significant figures]

Numerator		Denominator	
log 153 8	= 2 1869	log 276	= 2 4409
log 0137	= $\bar{2}$ 1367	log 0038	= $\bar{3}$ 5798
log numerator	= 0 3236	log denominator	= 0 0207
	0 3236		
subtract	0 0207	antilog 0 3029	= 2 008
log fraction	= 0 3029		

19. [3302 7=3303 correct to four significant figures]

Numerator	Denominator.
log 3303=3 5189	log 0561=$\bar{2}$ 7490
log 14 3=1 1553	log 387=$\bar{1}$ 5877
log numerator=4 6742	log 0091=$\bar{3}$ 9590
4 6742	log denominator=$\bar{4}$ 2957
subtract $\bar{4}$ 2957	antilog 8 3785=2 391 × 10^8
log fraction=8 3785	

20 Let $x=5^8$
Then $\log x=8\log 5=0\ 6990\times 8=5\ 5920=\log(3\ 908\times 10^5)$

21 Let $x=11^6$
Then $\log x=6\log 11=1\ 0414\times 6=6\ 2484=\log(1\ 772\times 10^6)$

22. Let $x=7^7$
Then $\log x=7\log 7=0\ 8451\times 7=5\ 9157=\log(8\ 235\times 10^5)$

23 Let $x=13^5$
Then $\log x=5\log 13=1\ 1139\times 5=5\ 5695=\log(3\cdot 711\times 10^5)$

24 Let $x=\sqrt[7]{82\ 558}$, or $(82\ 558)^{\frac{1}{7}}$ Then $\log x=\frac{1}{7}\log(82\ 558)$
$=\frac{1}{7}\log(82\ 56)=\frac{1}{7}(1\ 9168)=0\ 6389=\log(4\ 354)$

25 Let $x=17^3\times 29^2$
Then $\log x=3\log 17+2\log 29=1\ 2304\times 3+1\ 4624\times 2$
$=6\ 6160=\log(4\ 130\times 10^6)$

26 Let $x=(2\ 301)^5$
Then $\log x=5\log(2\ 301)=0\ 3619\times 5=1\ 8095=\log(6\ 449\times 10)$

27 Let $x=(\cdot 089)^{\frac{4}{7}}$ Then $\log x=\frac{4}{7}\log(\cdot 089)=\frac{4}{7}(\bar{2}\ 9494)$
$=\frac{1}{7}(\bar{5}\ 7976)=\frac{\bar{7}+2}{7}=\frac{7}{7}\cdot\frac{9}{7}\cdot\frac{6}{7}=\bar{1}\ 3997=\log(2\ 510\times 10^{-1})$

28 Let $x=\dfrac{5^3\times 19^2}{6^5}$ Then $\log x=3\log 5+2\log 19-5\log 6$
$=0\ 6990\times 3+1\ 2788\times 2-0\ 7782\times 5=0\ 7636=\log 5\ 802$

29 Let $x=\dfrac{1}{(3\ 47)^4}$, or $(3\ 47)^{-4}$
Then $\log x=-4\log 3\ 47=0\ 5403\times(-4)$
$=-(2\ 1612)=-3+(3-2\ 1612)$ [See Art 367]
$=\bar{3}\ 8388=\log(6\ 900\times 10^{-3})$

30 Let v=fraction Then, correcting denom^r to four significant figures,

$\log v=\frac{1}{2}(\log 01367+\log 0296-\log 873\,5)$

$=\frac{1}{2}(\bar{2}\,1358+\bar{2}\,4713-2\,9412)$

$=\frac{1}{2}(\bar{7}\,6659)=\frac{1}{2}(\bar{8}+1\,6659)=\bar{4}\,8329=\log(6\cdot806\times10^{-4})$

31 Let v=fraction Then $\log v=\frac{1}{2}(\log 678+\log 9\,01-\log 0234)$

$=\frac{1}{2}(\bar{1}\,8312+9547-\bar{2}\,3692)=\frac{1}{2}(2\,4167)=1\,2084$

$=\log(15\,85)$, giving 16 for answer

EXAMPLES XXI e Page 435

1 From Art 376, $\log A=\log P+n\log R$

$\log A=\log 370+25\log 1\,04=2\,5682+25\times0\,0170$

$=2\,9932=\log 984\,5$, giving Rs 985

2 $A=\text{Rs } 250\times(1\,05)^5\times(1\,025)^4$

$\log A=\log 250+5\log 1\,05+4\log 1\,025$

$=2\,3979+5\times0\,0212+4\times0\,0107$

$=2\,5467=\log 352\,2$, giving Rs. 352

3 From Art 376, it follows that

$\log P=\log A-n\log R=\log 3000-15\log 1\,035=3\,4771-15(0\,0149)$

$=3\,2536=\log 1793$, giving £1793

4 From Art 376, $n=\dfrac{\log A-\log P}{\log R}=\dfrac{\log 3000-\log 1130}{\log 1\,05}$

$=\dfrac{3\,4771-3\,0531}{0\,0\,212}=\dfrac{0\,4\,240}{0\,0\,212}=20$ years

5 If n be the req^d no of years, then, as in 4,

$n=\dfrac{\log 450-\log 270}{\log 1\,04}=\dfrac{2\,6532-2\,4314}{0\,0170}=\dfrac{0\,2218}{0\,017}=13$,

son will be (8+13), or 21 years old

6 Let N be the req^d population Then $N=4459000\times(0\,9477)^3$,

$\log N=\log 4459000+3\log(0\,9477)=6\,6493+3\times\bar{1}\,9766$

$=6\,5791=\log(3794000)$, giving 3794000

7 If v be the mean proportional, then $v^2=2\,87\times30\,08$

$2\log v=\log 2\,87+\log 30\,08=0\,4579+1\,4782=1\,9361$,

$\log v=0\,9680$, and $v=9\,290$

If y be the third proportional, then $y=\dfrac{(7\,805)^2}{0\,0238}$,

and $\log y=2\log 7\,805-\log(0\,0238)$

$=1\,7848-\bar{2}\,3766=3\,4082$,

$y=2560$

8 $f=\frac{2s}{t^2}=\frac{2\times 289\,3}{(\frac{31}{8})^2}=\frac{578\,6\times 8^2}{31^2}$,

$\log f=\log 578\,6+2\log 8-2\log 31=2\,7624+1\,8062-2\,9828$
$=1\,5858$, and $f=38\,53$

9 If w kilograms be req^d weight, $w=0\,00776\times 540\times 36\times 22$
$\log w=\log(\,00776)+\log 540+\log 36+\log 22$
$=\bar{3}\,8899+2\,7324+1\,5563+1\,3424=3\,5210$
$w=3319$ Kg

10 From formula we get
$\log t=\log\tau+\frac{1}{2}(\log l-\log g)=\log 3\,142+\frac{1}{2}(\log 150-\log 981)$
$=0\,4972+\frac{1}{2}(2\,1761-2\,9917)=0\,4972+\frac{1}{2}(\bar{1}\,1844)$
$=0\,4972+\frac{1}{2}(\bar{2}+1\,1844)=0\,4972+\bar{1}\,5922=0\,0894$,
$t=1\,228=1\,23$ secs (nearly)

11 We have $r^3=\frac{3V}{4\pi}$, $\log r=\frac{1}{3}(\log 3+\log V-\log 4-\log\pi)$
$\log r=\frac{1}{3}(\log 3+\log 248\,6-\log 4-\log 3\,142)$
$=\frac{1}{3}(0\,4771+2\,3956-0\,6021-0\,4972)$
$=\frac{1}{3}(1\,7734)=0\,5911$,
$r=3\,9$ cm

12 As in No 11, $\log r=\frac{1}{3}(\log 3+\log V-\log 4-\log\pi)$
$\log r=\frac{1}{3}(\log 3+\log(18\,2)^3-\log 4-\log\pi)$
$=\frac{1}{3}(0\,4771+3\times 1\,2601-0\,6021-0\,4972)$
$=\frac{1}{3}(3\,1581)=1\,0527$,
$r=11\,29$ cm and diam$^r=22\,58$ cm

13 If x be req^d value, then $\log x=\log m+2\log v-\log 2$
$\log x=\log 9\,17+2\log 17\,64-\log 2$
$=0\,9624+2\times 1\,2465-0\,3010$
$=3\,1544$, and $x=1427$

14. We have $\log F=\log m+2\log v-\log g-\log r$
$=\log 24\,7+2\log 60-\log 32\,19-\log 8\,4$
$=1\,3927+2\times 1\,7782-1\,5077-0\,9243$
$=2\,5171$ $F=329$

15 We have $2\log v=\log g+\log\tau-\log 289$
$=\log\frac{32\,2}{5280}+\log 4000-\log 289$
$=\log 32\,2-\log 5280+\log 4000-\log 289$
$=1\,5079-3\,7226+3\,6021-2\,4609=\bar{2}\,9265$,
$\log v=\frac{1}{2}(\bar{2}\,9265)=\bar{1}\,4632$ and $v=0\,2905$

If $v=\frac{2\pi r}{V\times 60\times 60}$, $\log v=\log 2+\log\pi+\log r-\log v-2\log 60$,

or $\log v=\log 2+\log 3\,142+\log 4000-\log(0\,2905)-2\log 60$

$=0\,3010+0\,4972+3\,6021-\bar{1}\,4632-3\,5564$

$=1\,3807$ Hence $x=24$ (nearly)

16 Let W lbs be the req^{d} weight of water

Then W = 62 3 lbs × ($\frac{1}{5}$ of vol of roller in cu ft)

$=62\,3\times\frac{4}{5}\ \frac{\pi r^2 l}{1728}$

$\log W=\log 62\,3+\log 4+\log\pi+2\log r+\log l-\log 1728-\log 5$

$=\log 62\,3+\log 4+\log 3\,142+2\log 13+\log 36$

$-\log 1728-\log 5$

$=1\,7945+0\,6021+0\,4972+2\,2278+1\,5563$

$-3\,2375-0\,6990$

$=\left\{\begin{matrix}1\,7945\\0\,6021\\0\,4972\\2\,2278\\1\,5563\end{matrix}\right\}-\left\{\begin{matrix}3\,2375\\0\,6990\end{matrix}\right\}=2\,7414$

$6\,6779$ $\qquad$ $3\,9365$

W = 551 lbs

17 Let h cm be the req^{d} height Then $\frac{h^3}{(14\,2)^3}=\frac{1}{2}$ (See Art 284, III)

$\log h=\frac{1}{3}(3\log 14\,2-\log 2)=\frac{1}{3}(3\,4569-0\,3010)$

$=\frac{1}{3}(3\,1559)=1\,0520$, $\qquad h=11\,3$ cm

18 Let h cm be the req^{d} height

For the 3 dl pot we have $\frac{h^3}{(12\,6)^3}=\frac{(1\,76\times 0\,3)\text{ pints}}{1\text{ pint}}$, and

$3\log h=3\log 12\,6+\log 1\,76+\log 0\,3=3\,3012+0\,2455+\bar{1}\,4771$

$=3\,0238$, $\qquad \log h=1\,0079$, and $h=10\,2$ cm

For the 5 dl pot we shall have

$3\log h=3\log 12\,6+\log 1\,76+\log 0\,5=3\,3012+0\,2455+\bar{1}\,6990$

$=3\,2457$, $\qquad \log h=1\,0819$, and $h=12\,1$ cm

For the 1 lit pot we shall have

$3\log h=3\log 12\,6+\log 1\,76+\log 1=3\,3012+0\,2455$

$=3\,5467$, $\qquad \log h=1\,1822$, and $h=15\,2$ cm

19 We have from Art 376, $n=\frac{\log A-\log P}{\log R}$,

$n=\frac{\log 100-\log 50\,38}{\log 1\,025}=\frac{2-1\,7023}{0\,0107}=\frac{0\,2977}{0\,0107}=28$ yrs.

20 We have $d^2=\frac{V}{0\,7854h}$, where V is volume of cylinder

$$2\log d=\log V-\log(0\,7854)-\log h$$
$$=\log\tfrac{3\cdot1416}{1\cdot3\cdot6}-\log(0\,7854)-\log 15\,3$$
$$=\log 25\,6-\log 1\,3\,6-\log(0\,7854)-\log 15\,3$$
$$=1\,4082-1\,1335-\bar{1}\,8951-1\,1847$$
$$=\bar{1}\,1949, \qquad \log d=\bar{1}\,5974, \text{ and } d=0\,3958 \text{ cm}$$

21 From formula in No 20,

$$\log h=\log V-\log(0\,7854)-2\log d$$
$$=\log\frac{150\times10^3}{8\,88}-\log(0\,7854)-2\log(0\,3)$$
$$=\log(450\times10^3)-\log 8\,88-\log(0\,7854)-2\log(0\,3)$$
$$=5\,6532-0\,9484-\bar{1}\,8951-\bar{1}\,0512$$
$$=7\,8555, \qquad h=71690000 \text{ cm}=716900 \text{ m}$$

22 Let $r=\sqrt{(3d)^5\times H-L}$. $\log r=\frac{1}{2}(5\log(3d)+\log H-\log L)$,

or $\log r=\frac{1}{2}\{5(\log 3+\log d)+\log H-\log L\}$
$$=\tfrac{1}{2}\{5(\log 3+1\,25)+\log 38-\log 1760\}$$
$$=\tfrac{1}{2}\{5\times(0\,4771+0\,6284)+1\,5798-3\,2455\}$$
$$=\tfrac{1}{2}\{5\,5275+1\,5798-3\,2455\}$$
$$=\tfrac{1}{2}(3\,8618)=1\,9309,$$
$$r=85\,29 \text{ gallons}$$

23 Let v in be req^d pressure Then $r=(\frac{130}{147})^{16}\times30$ in first case

$$\log v=15(\log 130-\log 147)+\log 30$$
$$=15(2\,1139-2\,1673)+1\,4771$$
$$=15\times(\bar{1}\,9466)+1\,4771=\bar{1}\,1990+1\,4771=0\,6761$$
$$r=4\,743 \text{ in}$$

In second case we get

$$\log r=50\times\bar{1}\,9466+1\,4771=\bar{3}\,3300+1\,4771=\bar{2}\,8071,$$
$$r=0\,06413$$

24 If x sq ft be req^d area, then $x=\frac{4\times12}{3}\sqrt{(0\,626\times12)^2+16^2}$

i e $r=16\sqrt{(0\,626)^2\times3^2\times4^2+16^2}=16\times4\sqrt{(0\,626)^2\times3^2+4^2}$

$$=16\times4\times2\sqrt{(0\,313)^2\times3^2+2^2}=128\sqrt{4\,882}$$

$$\log r=\log 128+\tfrac{1}{2}\log(4\,882)=2\,1072+\tfrac{1}{2}(0\,6886)$$
$$=2\,1072+0\,3443=2\,4515,$$
$$x=280 \text{ sq ft}$$

Most of the graphical examples in this set depend on the methods of Arts 377 and 378 In many cases a reference to a diagram will be all the solution necessary

1 Mark off OY=60′ to represent 60 miles Through Y draw YZ parallel to OX

Join O to the point whose abscissa along OX represents 1 hour, and whose ordinate measured up from OX is 12 miles. The ordinate of any point on this line will measure the distance travelled towards Y by the first rider

Join Y to the point whose abscissa along YZ represents 1 hour, and whose ordinate measured downwards from YZ represents 9 miles The resulting line will shew the distance travelled towards O at the end of any time (For this line all ordinates must be drawn to YZ)

The two lines cut at the point whose abscissa is 2 86″, which on the given scale represents 2 hrs 52 min

The vertical distance between the lines is 1 8′ for the abscissa 2 0′, *i e* the riders are 18 miles apart after 2 hrs

2 Take the scale as in Ex 1 The graph representing *A*'s motion is the line joining the origin to the point (1 0′, 0 6′) *B*'s graph is found by joining (1 5′, 0) to (2 5″, 0 8′) These two lines meet at the point (6 0″, 3 6′) Hence the time of meeting is 6 0 p m

Measuring the difference between the ordinates of corresponding points on the two lines, we find that *A*'s graph is 0 5′ above *B*'s for the abscissa marking 3 30 p m, and that therefore *A* is 5 miles ahead of *B* at that time Similarly *B* is 3 miles ahead at 7 30 p m

3 A convenient scale is 25 miles to the inch vertically, and 1 hour to the inch horizontally The graphs are shewn on half this scale in Fig 17 The answers are given by the coordinates of P and the abscissa of LM, HK

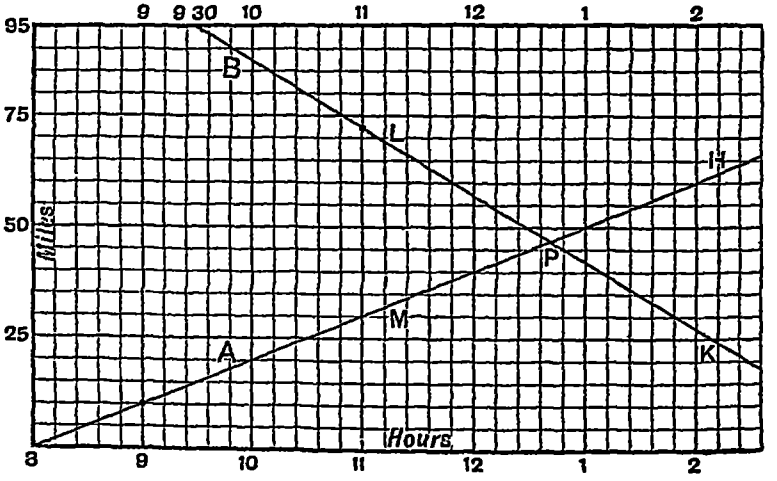


Fig 17

4. Let Rs y represent the salary after x years, Rs a, Rs b the annual increase and the initial salary respectively

Then we have the relation $y=ax+b$, which is the equation of a straight line A scale of Rs 800 to the inch vertically, and 10 years to the inch horizontally will be found convenient The line can then be drawn by joining the points (6, 1280) and (15, 2000) The initial salary is given by the intercept on OY, and the salary for the 21st year is given by the ordinate corresponding to an abscissa 20

5 CP $+\frac{15}{100}$ of CP $=16s\ 4d$, CP $=\frac{100}{112}$ of $16s\ 4d=14s\ 7d$

Profit on each article $=£10\ 18s\ 9d-100=2s\ 2\frac{1}{4}d$

Selling Price $=14s\ 7d+2s\ 2\frac{1}{4}d=16s\ 9\frac{1}{4}d$

6 Reckoning in thousands, the total no of gallons supplied

$=16\cdot5\times610+17\cdot9\times730+15\cdot3\times520=10065+13067+7956=31088$

The total population $=610+730+520=1860$,

average supply per head $=\frac{31088}{1800}=16\cdot7$

7 Suppose he holds £x stock, his income from this is $£\frac{21}{100}$ of x,

and after income-tax has been deducted, it $=£\frac{19}{20}$ of $\frac{21}{100}$ of x,

$\frac{19}{20}$ of $\frac{21}{100}$ of $x=448\frac{8}{10}$, and $x=\frac{8908\times200\times20}{20\times5\times19}=£18880$

8 A runs $3\frac{1}{2}\times9$ ft while B runs $4\frac{1}{4}\times7$ ft,

or A „ 14×9 ft „ B „ 17×7 ft,

or A „ 126 ft „ B „ 119 ft,

A catches B in 126 ft when B has a start of 7 ft,

or A „ B „ 18 ft „ B „ „ 1 ft,

or A „ B „ 18×25 yds „ B „ „ 25 yds

A must run 18×25 yds, or 450 yds

9 The graphs are shewn in Fig 18 A's graph is the broken line XDEM, his rest of half an-hour being shewn by the horizontal line DE B's graph is the line HKN The solutions are given by the abscissæ of P and of the points where KL, MN meet the hour-axis

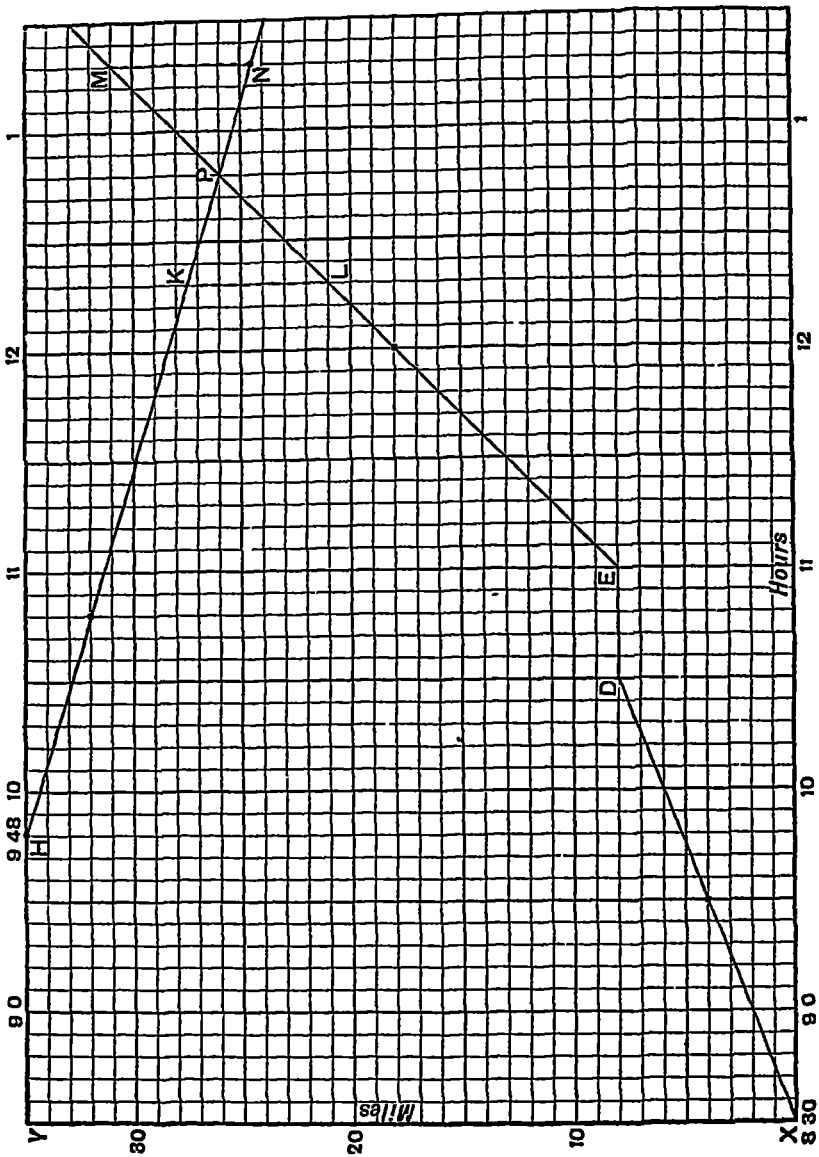


FIG 18

10 See Fig 19 OY is of any convenient length and represents the time taken by A to run 120 yards In the same time B and C would run 100 yards and 80 yards respectively Hence the graphs of the three runners are found by joining O to the points marked A, B, C in the figure Find the point Q on OB which corresponds to an abscissa 80 yards, and draw a horizontal cutting OC, OA in R and P Then the distances run by C and A when B has gone 80 yards are given by the abscissæ of R and P

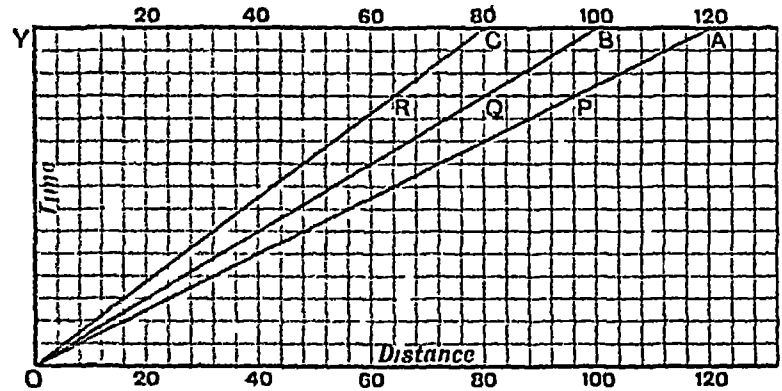


Fig 19

11. Fig 20 is drawn on a reduced scale

A's graph is the line OP

Since B has a start of 8 yds R is a point on his graph

Also B beats A by 1 second, S is a point on his graph

Thus B's graph is the line RS

A beats C by 40 yds, Q is a point on C's graph

Find T the point on B's graph corresponding to 15 seconds, and measure TK downwards to represent 18 yds Then K is also a point on C's graph

Thus C's graph is the line QK When produced this meets the time axis at L Then, since OL represents 5 seconds, C must have started 5 seconds after A

As the graphs are three *parallel* lines, the speeds of the runners, which are measured by the slopes of the lines, are equal and the race would end in a dead heat

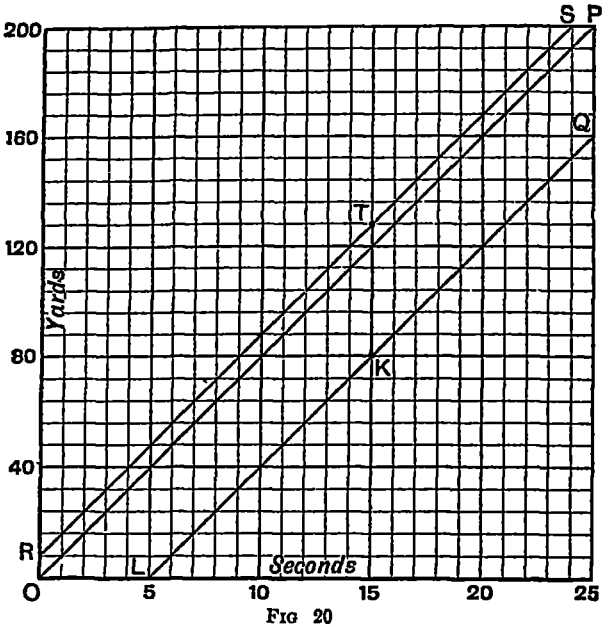


FIG 20

12 Let d ft be the req^{d} depth

cu ft of water in cistern $= 5 \times 4 \times d$,

cu ft of water on roof $= 20 \times 12 \times \frac{2}{12}$

$5 \times 4 \times d = 20 \times 12 \times \frac{2}{12}$, and $d = 2$

13 fr 25 105 = £1,

fr 430 50 = £$\frac{4\,3\,0\;5\,0}{2\,5\;1\,0\,5}$

	17 148
25105	43050
	179450
	3715
	1204
	200

14 The S I for 3 yrs at 5 % = $\frac{5}{100}$ of Rs $401\frac{5}{8} \times 3$ = Rs 60 4 a

The amount at C I for 3 yrs at 5 %

= Rs $410\frac{5}{8} \times (1\ 05)^3$ = Rs $\frac{3\,2\,1\,3}{8} \times 1\ 157625$

= Rs $3213 \times 0\ 144703125$ = Rs 464 931

= Rs 464 15 a

	0 144703125
	3213
434 109	4
28 940	6
1 447	0
434	1
464 931	1

C I = Rs 464 15 a − Rs 401 10 a = Rs 63 5 a

req^{d} diff = Rs 63 5 a − Rs 60 4 a = Rs 3 1 a

15 Space left uncovered $=(30\times28-27\frac{1}{2}\times25\frac{1}{2})$ sq ft $=\frac{555}{4}$ sq ft

This would cost Rs $420\times\frac{\frac{555}{4}}{30\times28}$, or Rs $69\frac{3}{8}$, to carpet

Rs $69\frac{3}{8}$, or Rs 69 6a, is saved

16 1 lb av $=7000$ gr of pure gold

Each £ contains $\frac{11}{12}$ of 123 gr of pure gold If x be req^{d} number, we have $\frac{11}{12}$ of $123\times x=7000$, whence $x=\frac{84000}{1353}=62\frac{114}{1353}$

Thus 62 sovereigns can be coined

17 (Fig 21) A's graph is found by joining X to P Find the point R on this line which corresponds to 4 p m Then R is a point on B's graph Thus B's graph is the line joining Q and R The solutions can now be read off from the figure

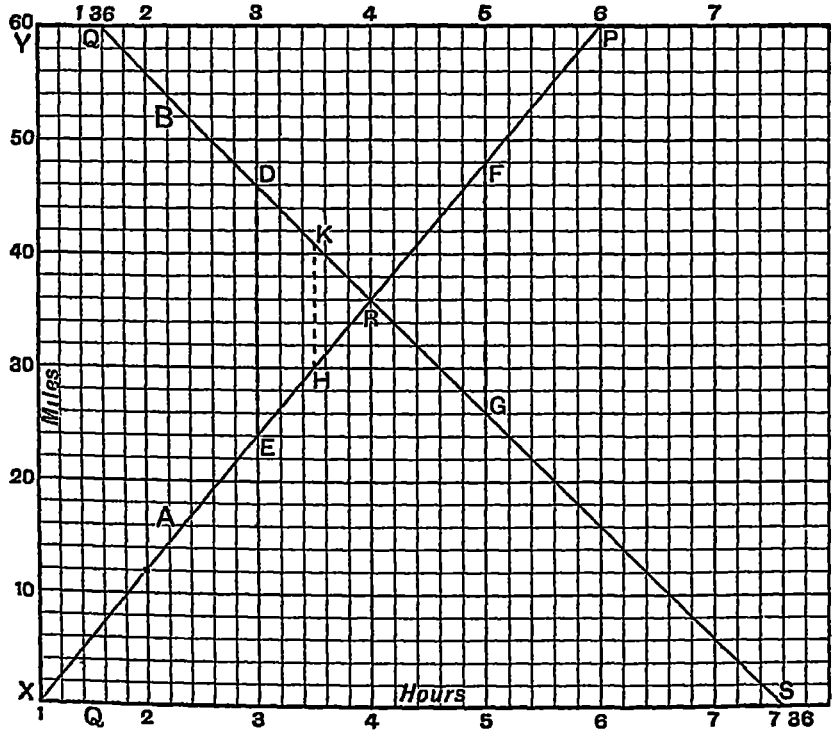


Fig 21

18 Since one goes 8 miles while the other goes 4 miles, the speed of the first is twice that of the second Let their speeds be $2a$ miles and a miles per hour respectively, and let them meet x miles from B

The first goes $(12+x)$ miles in $\frac{12+x}{2a}$ hours, the second goes $(12-x)$ miles in $\frac{12-x}{a}$ hours, $\frac{12+x}{2a}=\frac{12-x}{a}$

Multiply by $2a$, then $12+x=2(12+x)$, and $x=4$

For graphical verification, take a scale of 2 miles to the inch vertically and suppose A at the origin The rates are as 2 1 Take as the unit of time that interval during which the faster goes 8 miles, the slower 4 miles Represent this unit by 4 in on the x axis, and along it mark 4 in, 8 in, 12 in, from the origin, 1, 2, 3 respectively

The graph of the faster will then be obtained by joining the point (1, 8) to the origin It passes through the point (1 5, 12) Now join the last point to the point (3, 0), and we clearly obtain the graph for the return journey of the faster traveller Similarly the graph of the slower traveller is the line joining the point (1, 4) to the origin it cuts the 'return' graph of the faster at the point (2, 8), shewing the men meet 8 miles from A *i e* 4 miles from B

19 See Fig 22 A scale of 30 miles to the inch vertically, and 1 hr to the inch horizontally will be found more convenient than the one here employed

The beginning and end of his journey, being at different speeds, will be represented by different graphs These are obtained by joining A to P and B to Q The abscissa of the point of intersection of AP and BQ will give the required time

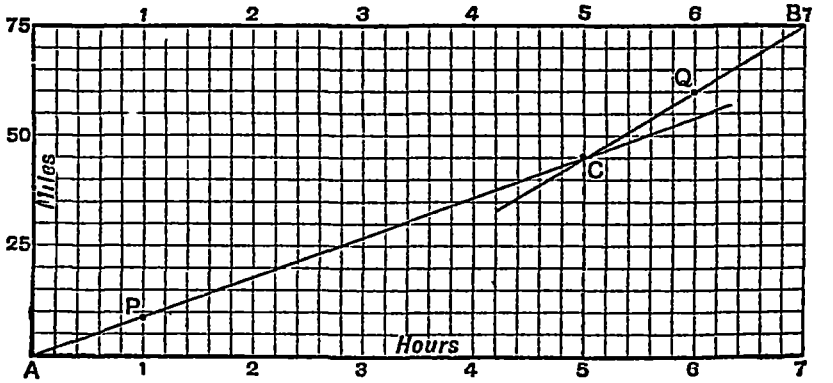


Fig 22

20 Total increase $=185000\times\frac{0\ 482}{100}+235000\times\frac{0\ 324}{100}+325000\times\frac{0\ 516}{100}$

$=891\ 7+761\ 4+1677=3330\ 1$

If x % be the average increase,

the total increase $=\frac{x}{100}$ of $(185000+235000+325000)$

$=x(1850+2350+3250)=7450x$,

$7450x=3330\ 1$ and $x=0\ 447$ %

21 The total receipts for the first four months $=£1555\ 1s$

The receipts for the remaining eight months must be

$£5000-£1555\ 1s$, or $£3444\ 19s$,

req^{d} average takings $=\frac{£3444\ 19s}{8}=£430\ 12s\ 4\frac{1}{2}d$

22 Since $7931520=765\times2^{7}\times3^{4}$, it follows that the only pairs are

$\{765,\ 765\ 2^{7}\ 3^{4}\}$ and $\{765\ 2^{7},\ 765\ 3^{4}\}$,

because, when we divide the numbers forming each pair by 765, the quotients are prime to each other For if they were not, their H C F would not be 765 This may be seen in the case of such a pair as $765\ 2^{3}\ 3^{2}$ and $765\ 2^{7}\ 3^{4}$, the H C F is not 765 but $765\ 2^{3}\ 3^{2}$ Again taking another pair, 765 and 765×2^{7}, their L C M is 765×2^{7}, or 6120, not 7931520 In the same way any other case may be dealt with

23 Let the sides be $2x$ ft and $3x$ ft Area $=6x^{2}$ sq ft

and cost $=$ Rs $\frac{4}{10\times9}\times6x^{2}$, $\frac{4}{10\times9}\times6x^{2}=24$,

and $x^{2}=144$, or $x=12$,

hence lengths are 24 ft and 36 ft respectively

24. The company pays out $\frac{4\frac{1}{2}}{100}$ of Rs 20000000 as interest on mortgage.

If Rs x be the gross annual receipts, then expenses are $\frac{40x}{100}$,

then net annual receipts are $x-\frac{40}{100}x-\frac{4\frac{1}{2}}{100}$ of Rs 20000000

this must be equal to the interest on the shareholders' capital, viz 5 % of Rs 40000000

$$x - \frac{40x}{100} - \frac{4\frac{1}{2}}{100} \text{ of Rs } 20000000 = \frac{5}{100} \text{ of Rs } 40000000,$$

$$\text{or } \frac{60x}{100} - 900000 = 2000000, \text{ and } x = \text{Rs } \frac{29000000}{6}$$

the average weekly receipts

$$= \text{Rs } \frac{29000000}{6 \times 52}$$

$$= \text{Rs } \frac{29000000}{312}$$

$$= \text{Rs } 92948\ 11\text{a}$$

```
                92948 72
312 ) 29000000
        920
        2960
        1520
        2720
        2240
         560
```

25 18 eggs cost 12a, or 12 eggs cost 8a, but 12 eggs are sold for $10\frac{1}{2}$a, gain is $2\frac{1}{2}$a on an outlay of 8a, giving $\frac{2\frac{1}{2}}{8} \times 100$, or $31\frac{1}{4}$ %

26 £17 5*s* 7*d* = £17 279 | 1666 = value of 1 ton
40

	£691 166	6	= value of 40 tons	
2 cwt = $\frac{1}{10}$ of 1 ton	1 727	9	= „	2 cwt
8 lbs = $\frac{1}{14}$ of 1 cwt	061	7	= „	8 lbs
4 lbs = $\frac{1}{2}$ of 8 lbs	030	9	= „	4 lbs
	£692 987	1	= value of 40 tons 2 cwt 12 lbs	

Giving £692 19*s* 9*d*

27 Let the weights of unit volumes be 4*s*, 5*s* and 6*s* ounces respectively, and let the substances contain 3*v*, 4*v* and 5*v* units of volume respectively Then the respective weights are $4s \times 3v$, $5s \times 4v$ and $6s \times 5v$ ounces, or $12sv$, $20sv$ and $30sv$ ounces Now 5 lbs 13 oz = 93 oz

$$12sv + 20sv + 30sv = 93, \text{ and } sv = \tfrac{1}{2} \text{ oz},$$

hence $12sv = 18$ oz, $20sv = 30$ oz, $30sv = 45$ oz

Thus the weights are 1 lb 2 oz, etc

28 (Fig 23) Take 25 miles to the inch vertically, and 1 hour to the inch horizontally The figure shewn is drawn on half these scales

Measure off AB along the vertical axis to represent 119 miles and draw a horizontal through B Plot the points whose co-ordinates represent (1 hr , 26 miles), (2 hrs , 49 miles), (3 hrs , 69 miles) etc , and join each successive pair as in the diagram The horizontal through B is seen to be cut at a point on the '7' ordinate Hence B is reached at 7 p m

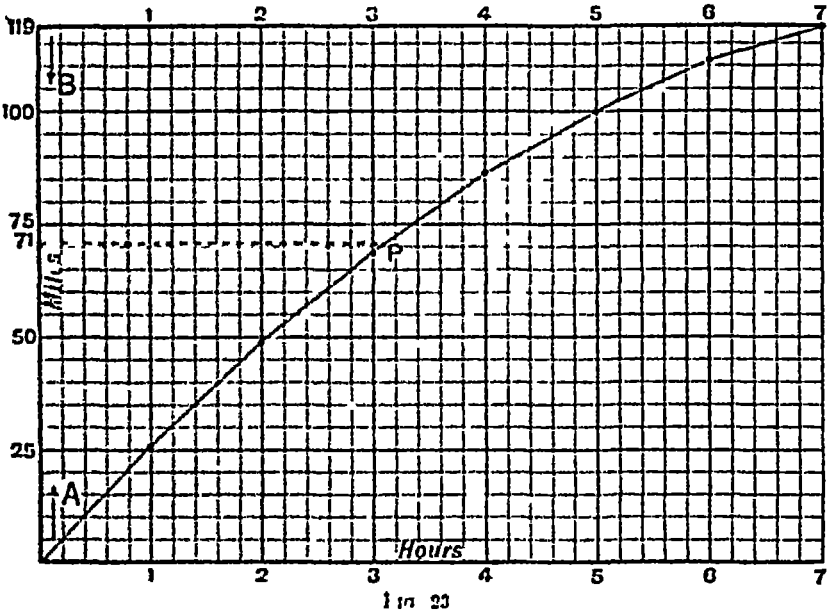


Fig 23

The horizontal through the point whose ordinate represents 48 mls from B (or 71 mls from A) cuts the graph at P, whose abscissa represent 3 7 p m approximately

29 Increase of acreage between 1895 and 1900 =103770 ac , and this corresponds to 48000000 lbs

1 ac contains $\frac{48000000}{103770}$ lbs ,

or 218 lbs

For second part of question,

decrease of acreage = 1197 ac

decrease of crop = $\frac{48000000}{103770} \times 1197$ lbs

= 296500 lbs nearly

	2177
103770)	48000000
	9216
	1196
	110
1197 × 18 =	57546
	296517
19377)	5715600000
	187020
	126270
	10008
	208
	15

30 (Fig 24) The graph for the X to Y train must be obtained by joining the points whose coordinates, measured from X are (0, 2 33) and (35, 3 33) For at 2 33 p m the train is still at X, and at 3 33 p m has travelled 35 miles

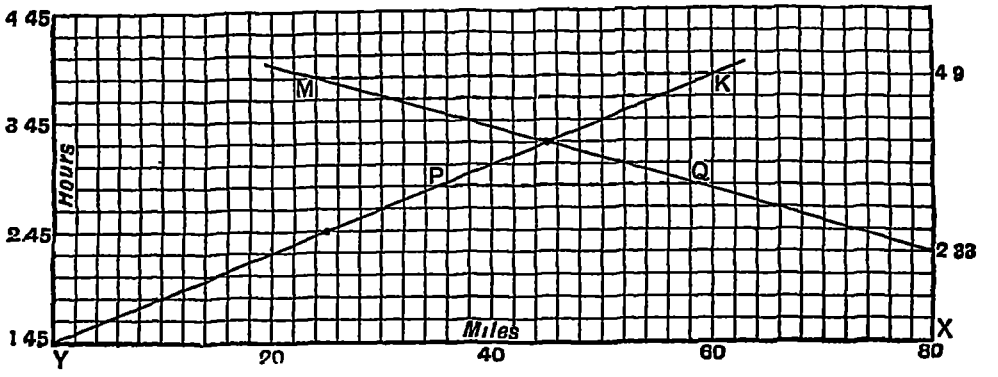


FIG 24

31 1 bigha is rented at Rs 600

Now 1 bigha $=(1600\times 9)$ sq ft

hence (1600×9) sq ft are rented at Rs 600

(34×125) sq ft are rented at Rs $\frac{600\times 34\times 125}{1600\times 9}$, or Rs $\frac{2125}{12}$,

or Rs 177 083, giving for answer Rs 177 1a 3p

32 Let x rupees be the marked price He sells at $\frac{90}{100}x$ rupees But he gains 15 % on an outlay of Rs 72,

he sells at Rs $72\times\frac{115}{100}$,

hence $\frac{90x}{100}=72\times\frac{115}{100}$, and $x=$Rs 92

33 Since A's wages are greater than B's *for the same time*, we must multiply £1 10*s* by $\frac{£1\ 16s\ 8d}{£1\ 8s\ 9d}$, or $\frac{440d}{345d}$

Again, since A takes less time than B *for the same piece of work*, we must multiply £11 10*s* by $\frac{2\frac{1}{2}}{3\frac{1}{3}}$ (See Art 279)

$$\text{req}^{\text{d}}\ \text{charge}=£11\tfrac{1}{2}\times\frac{440}{345}\times\frac{2\frac{1}{2}}{3\frac{1}{3}}=£11$$

34 For first period total crop
=(13 224 × 15 2) million bushels
=201 million bushels

For second period total crop
=(17 198 × 18) million bushels
=310 million bushels

13	224
1	5 2
132	2
66	1
2	6
200	9
17	198
1	8
172	0
137	5
309	5

For first period, amount of wheat per head

$$= \frac{201}{33\cdot4} \text{ bushels} = 6 \text{ bushels}$$

For second period, amount of wheat per head

$$= \frac{310}{38} \text{ bushels} = 8\cdot1 \text{ bushels}$$

35 If the total expenses for x boys are represented by £y, the variable part may be denoted by £ax, and the constant part by £b. Hence x and y satisfy a linear equation $y = ax + b$, where a and b are constant quantities. Hence the graph is a straight line. (See Art. 378.)

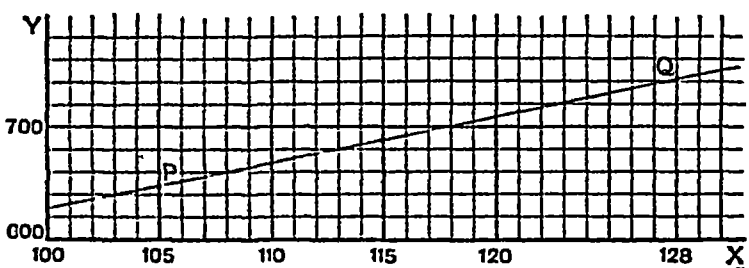


Fig. 25.

As the numbers are large, it will be convenient if we begin measuring ordinates at 600, and abscisse at 100. This enables us to bring the requisite portion of the graph into a smaller compass. When $x = 105$, $y = 650$, and when $x = 128$, $y = 742$. Thus two points P and Q are found, and the line PQ is the required graph.

By measurement we find that when $x = 115$, $y = 690$, and that when $y = 710$, $x = 120$. Thus the required answers are £690, and 120 boys.

36 As in Ex. 35 the graph must be a straight line Hence we need only join the points (12, 3840) and (16, 4320) and then read off the ordinate corresponding to an abscissa 15

A convenient scale is that of 5 patients to the inch horizontally and Rs 200 to the inch vertically The vertical graduation may commence at Rs 3500

37 Let the respective populations be $3x$ and $8x$, then the total population is $11x$,

the total number of males is $\frac{42}{100}\times 3x+\frac{46}{100}\times 8x$ in $11x$,

or $\frac{494x}{100}$ in $11x$, or $\frac{494x}{100}\times\frac{100}{11x}$ in 100, or $\frac{494}{11}$ in 100, giving 45 %

38 Internal edge $=1$ m $=100$ cm , external edge $=102$ cm ,

volume of metal $=(102^3-100^3)$ cu cm $=61208$ cu cm

weight of metal $=61208$ gm $\times 7=428\,456$ Kg

39 Error $=£(\frac{567}{900}-\frac{567}{1000})$ in $£\frac{567}{900}=£(\frac{1}{900}-\frac{1}{1000})$ in $£\frac{1}{900}$

$=£(100-96)$ in £100, or 4 %

Again error $=\frac{4}{100}$ of 567 f $=4\times 5\,67$ f $=22\,68$ f, or 23 f

40 After the first replacement,

the first cask contains	the second cask contains
{48 gals of wine, 12 gals of water},	{12 gals of wine, 18 gals of water},
i e {$\frac{4}{5}$ of cask is wine, $\frac{1}{5}$ of cask is water}	i e {$\frac{2}{5}$ of cask is wine, $\frac{3}{5}$ of cask is water}

The 12 gallons then drawn,

from the first cask contain	from the second cask contain
$\frac{4}{5}$ of 12 gals of wine	$\frac{2}{5}$ of 12 gals of wine

The amount left,

in the first cask is	in the second cask is
48 gals of wine and water,	18 gals of wine and water,
of which $\frac{4}{5}$ of 48 gals is wine	of which $\frac{2}{5}$ of 18 gals is wine

after the second replacement,

the first cask contains	the second cask contains
$(\frac{4}{5}$ of $48+\frac{2}{5}$ of $12)$ gals of wine, or $\begin{cases} 43\frac{1}{5} \text{ gals of wine} \\ 16\frac{4}{5} \text{ gals of water} \end{cases}$,	$(\frac{2}{5}$ of $18+\frac{4}{5}$ of $12)$ gals of wine, or $\begin{cases} 16\frac{4}{5} \text{ gals of wine} \\ 13\frac{1}{5} \text{ gals of water} \end{cases}$,
i e $\begin{cases} \frac{43\frac{1}{5}}{60} \text{ or } \frac{14}{15} \text{ of cask is wine} \\ \frac{16\frac{4}{5}}{60} \text{ or } \frac{4}{15} \text{ of cask is water} \end{cases}$,	i e $\begin{cases} \frac{16^4}{30} \text{ or } \frac{14}{15} \text{ of cask is wine} \\ \frac{13^1}{30} \text{ or } \frac{1}{15} \text{ of cask is water} \end{cases}$

The 12 gallons then drawn,

from the first cask contain	from the second cask contain
$\frac{14}{15}$ of 12 gals of wine	$\frac{14}{15}$ of 12 gals of wine

The amount left,

in the first cask is	in the second cask is
48 gals of wine and water, of which $\frac{14}{15}$ of 48 gals is wine	18 gals of wine and water, of which $\frac{14}{15}$ of 18 gals is wine

after the third replacement,

the first cask contains	the second cask contains
$(\frac{14}{15}$ of $48+\frac{1}{15}$ of $12)$ gals of wine, or 41 28 gals of wine	$(\frac{14}{15}$ of $18+\frac{14}{15}$ of $12)$ gals of wine, or 18 72 gals of wine

41 3 men and 4 boys do $\frac{1}{6}$ of the work in 1 day,

but 3 men „ 1 boy „ $\frac{1}{8}$ „ „ 1 day,

3 boys do $(\frac{1}{6}-\frac{1}{8})$, or $\frac{1}{24}$ „ „ 1 day,

and 8 boys „ $\frac{1}{24}\times\frac{8}{3}$, or $\frac{1}{9}$ „ „ 1 day

But 4 women and 8 boys do $\frac{1}{5}$ „ „ 1 day,

4 women do $(\frac{1}{5}-\frac{1}{9})$, or $\frac{4}{45}$ „ „ 1 day,

and 1 woman does $\frac{1}{45}$ „ „ 1 day,

giving 45 days for req^{d} time

42 £32 17s 11¼d

=£32 89	6875
2	5 11
657 93	7
164 48	4
3 29	0
32	9
fi 826 04	0

43 9 big 18 cot 2 chk $=\left(9+\frac{18}{20}+\frac{2}{16\times20}\right)$ big

=9 90625 big

Rs 1664 4a =Rs 1664 25

req^{d} ground rent

=Rs $\frac{1664\ 25}{9\ 90625}$

=Rs 168

168

9 90625) 1664 250

673 6250

79 2500

44 $\left(1\ 24\times\frac{4\ 4}{1\ 4\ 4}\right)$ cu ft pass per 1″,

time req^{d} $=\frac{5\ 2\times3\ 5\times2\ 1\times1\ 4\ 4}{1\ 2\ 4\times4\ 4}$ secs

$=\frac{1\ 2\ 6\ 0\times2\ 7\ 3}{3\ 4\ 1}$ secs

=100874 secs

=28 hr 1 min 14 secs

273 × 1260 = 343980

100873 8

3 41) 343980

2980

2520

1330

307

60 | 100874

60 | 1681 14 secs

28 hr 1 min

45 We have $\frac{2}{5}$ of time on coach = 1 hr

time on coach $=\frac{5}{2}$, or 2½ hrs

Had he travelled this part of the journey by train, he would have been 1 hr less, or 1½ hrs But he would travel the whole distance by train in 2 hours distance by coach $=\frac{1\frac{1}{2}}{2}$ of 60 mi =45 mi

46 He has to pay back altogether in four years the equivalent of the amount of Rs 344810 at 5 % C I for that time

This =Rs 344810(1 05)^{4} (See Art 313)

=Rs 344810(1 21550625)

=Rs 419118 7

344810	0
	1 2155062
344810	
68962	
3448	1
1724	05
172	40
2	06
	06
419118	7

Since he pays by annual instalments of Rs 97240 8a, or Rs 97240 5, the first instalment paid at the end of the first year amounts to Rs 97240 5(1 05)^{3} in three more years at 5 % C I

Similarly the second instalment paid at the end of the second year amounts to Rs 97240 5(1 05)^{2} in two more years at 5 % C I

In the same way the third instalment amounts to Rs 97240 5(1 05) at the end of the time

With the last instalment, his payments amount to

Rs 97240 5(1 05³+1 05²+1 05+1),
or Rs 97240 5(4 310125),
or Rs 419118 7 as above

97240	5
	4 310125
388962	
29172	2
972	4
9	7
1	9
	5
419118	7

47 1 Nap $= \frac{0\ 180}{31}$ Kg $= \frac{0\ 180}{31} \times \frac{r}{2\ 68}$ lbs $= \frac{0\ 180 \times 6}{31 \times 2\ 268} \times 7000$ grs

$= £\frac{0\ 180 \times r \times 7000}{31 \times 2\ 268} \times \frac{6231}{70410}$,

$= £\left(\frac{6\ 31}{31}\right) \times \left(\frac{0\ 180}{2\ 68}\right) \times \frac{r \times 7000}{70410}$,

$= £201 \times \frac{1}{1\ 6} \times \frac{r \times 7000}{70410} = £\frac{r \times 7000}{3\ 15\ 6}$,

req^d number of Napoleons $= 31527$

48 Suppose he mixes x lbs of the first kind with y lbs of the second
It costs him $(3\frac{1}{2}x+5y)$ annas, he sells it at $4\frac{1}{2}(x+y)$

$4\frac{1}{2}(x+y) = \frac{10}{100} \times (3\frac{1}{2}x+5y)$, and multiplying by 100,

$450(x+y) = 102(3\frac{1}{2}x+5y)$, or $450x+450y = 357x+510y$,

$93x = 60y$, and $\frac{x}{y} = \frac{60}{93} = \frac{20}{31}$,

he mixes 20 of first kind with 31 of second

49 Exp^n is greater than $\frac{10 \times 2\ 4}{1\ 50000}$, or $\frac{10 \times 8 \times 2\ 4}{10000000}$, or $\frac{7\ 4\ 8}{10000000}$, or 0 0000748

Exp^n is less than $\frac{40 \times 2\ 5}{1\ 40000}$, or $\frac{100}{1\ 40000}$, or 0 00008

50 Let £x be the buying price, then $x \times \frac{105\frac{1}{2}}{100}$ is the selling price

Now a loss of $5\frac{1}{2}d$ in the £ leaves £$x \times \frac{234\frac{1}{2}}{240}$ out of £x

$\frac{105\frac{1}{2}x}{100} - 2\ 3375 = \frac{234\frac{1}{2}}{240}x$, or $\frac{211x}{200} - 2\ 3375 = \frac{469}{480}x$,

or $\left(\frac{211}{200} - \frac{469}{480}\right)x = 2\ 3375$, or $\frac{187}{2400}x = 2\ 3375$,

or $x = \frac{2\ 3375 \times 2400}{187} = 1\ 25 \times 24 = £30$

51 Let e shillings be the price of an English piece,
and f " " a French piece

Then $\frac{e}{f} = \frac{\text{area of English piece}}{\text{area of French piece}} = \frac{22\frac{1}{2} \times 12}{18 \times 9} = \frac{5}{3}$

$e = \frac{5}{3}$ of f, and we must multiply the prices of the French pieces by $\frac{5}{3}$

	On Level	Uphill	Downhill
52 In miles per hr	X's rate $= 4$, Y's rate $= 3$	X's rate $= 3$, Y's rate $= \frac{3}{4}$ of 3	X's rate $= 5$, Y's rate $= \frac{3}{4}$ of 5

Y reaches C in $\frac{6}{\frac{3}{4} \text{ of } 3}$ hrs, or $2\frac{2}{3}$ hrs, X reaches B in $\frac{8}{4}$ hrs, or 2 hrs, and in $\frac{2}{3}$ hr more he goes $(3 \times \frac{2}{3})$ mi, or 2 mi beyond B

at the end of $2\frac{2}{3}$ hrs, X and Y are $2\frac{1}{4}$ mi apart

X and Y then go towards each other at 3 mi an hr, and $\frac{3}{4}$ of 5 mi an hr respectively, their rate of approach (see Arts 216, 217) is $(3 + \frac{3}{4} \text{ of } 5)$, or $6\frac{3}{4}$ mi per hr, they meet in $\frac{2\frac{1}{4}}{6\frac{3}{4}}$ hr, or $\frac{1}{3}$ hr In this time Y will be $(\frac{3}{4} \text{ of } 5) \times \frac{1}{3}$, or $1\frac{1}{4}$ mi from C, they meet 11 miles from A

53 Take a scale of 1 in to 10 yds along the axis of y

Mark along the axis of x the points 0, 1, 2, 3, 4, etc, an inch apart

Let 1 in along the x-axis represent the time B takes to walk 20 yds Now, while B walks 6 yds, A walks $7\frac{1}{2}$, hence, while B walks 20 yds, A walks $20 \times \frac{7\frac{1}{2}}{6}$, or 25 yds

Since B has a start of 20 yds, we shall obtain his graph by joining the points (0, 20) and (1, 40) Similarly A's graph is obtained by joining the points (0, 0) and (1, 25)

(i) When B has walked 50 yds, he is (20+50), or 70 yds from the start From the graph A is then $62\frac{1}{2}$ yds from the start Hence A is $(70 - 62\frac{1}{2})$, or $7\frac{1}{2}$ yds behind B

(ii) When A has walked 130 yds, B will be seen from the graph to be 124 yds from the start Hence A is $(130 - 124)$, or 6 yds ahead

(iii) It will also be seen that when B is 116 yds from the start he is 4 yds behind A B must have walked $(116 - 20)$, or 96 yds

54 Along OX measure off OA=2 6″ to represent 2 hr 10 min On the vertical through A mark the point B, such that AB=1 0″ Then since the man's speed against the stream is $(4\frac{1}{2}-1\frac{1}{2})$, *i e* 3, mls per hr, the first part of his journey is represented by the line joining O to (1 2″, 1 5″) He returns at the rate of $(4\frac{1}{2}+1\frac{1}{2})$, *i e* 6, mls per hr, and at 2 10 is 2 mls from his starting point Hence the second part of his motion is shewn by a line drawn from B to represent 6 mls per hr This is found by joining B to the point whose abscissa, measured to the left of A, is 1 2″, and whose ordinate is 4 0′ The graphs cut at a point whose coords mark 5 mls and 1 hr 40 min Hence the distance rowed up stream was 5 miles

55 Let req^{d} height be h cm , then $\frac{h^3}{(12\ 4)^3}=\frac{1\ 76}{1}$,

$h^3=1\ 76\times(12\ 4)^3$, and $3\log h=\log 1\ 76+3\log 12\ 4$

or $\log h=\frac{1}{3}(2455+3\ 2802)=1\ 1752$, and $h=14\ 97$ cm.

56 Its value in 1 yr $=$Rs $27400\times 0\ 95$

Its value in 6 yrs $=$Rs $27400\times(0\ 95)^6$

$=$Rs $27400\times 0\ 735092$

$=$Rs $20141\ 5$

57 Suppose a man does $5a$ units of work per day

„ woman „ $3a$ „ „ „

„ boy „ $2a$ „ „ „

Then 10 men in 25 days do $5a\times 25\times 10$, or $1250a$ units,

„ 8 women „ 25 days „ $3a\times 25\times 8$, or $600a$ units,

„ 6 boys „ 25 days „ $2a\times 25\times 6$, or $300a$ units

Thus the work consists of $(1250a+600a+300a)$, or $2150a$ units, and three times the work consists of $(2150a\times 3)$ units

Again 19 men in 1 day do $(5a\times 19)$, or $95a$ units,

20 women „ 1 day „ $(3a\times 20)$, or $60a$ units,

30 boys „ 1 day „ $(2a\times 30)$, or $60a$ units,

giving a total of $(95a+60a+60a)$, or $215a$ units

they will do a work consisting of $(2150a\times 3)$ units in $\left(\frac{2150a\times 3}{215a}\right)$ days, or 30 days

58 4 lbs of A should be mixed with 7 lbs of B,

weight of A should be $\frac{4}{11}$ of weight of mixture

But 4 cu in of A is actually mixed with 7 cu in of B,

and since $\frac{\text{weight of 1 cu in of A}}{\text{weight of 1 cu in of B}} = \frac{151}{117}$,

$$\frac{\text{weight of 4 cu in of A}}{\text{weight of 7 cu in of B}} = \frac{151 \times 4}{117 \times 7} = \frac{604}{819},$$

and the weight of A actually is $\frac{604}{604+819}$, or $\frac{604}{1423}$ of weight of mixture

the percentage of A's weight actually is $\frac{604}{1423} \times 100$, or 42 445,

but the percentage of A's weight should be $\frac{4}{11} \times 100$, or 36 363,

error $= (42\,445 - 36\,363)\%$, or 6 08 %

59 $a = 0\,8$ in, $b = 0\,7$ in, $c = 1$ in

area of section in figure $= \left(0\,8 \times \frac{1\,7}{2}\right)$ sq in $= 0\,68$ sq in

area of section of haystack

$= (0\,68 \times 36)$ sq yds $= (0\,68 \times 36 \times 9)$ sq ft,

and its volume $= (0\,68 \times 36 \times 9 \times 30)$ cu ft

Hence its weight $= \frac{0\,68 \times 36 \times 9 \times 30 \times 10}{2240} = \frac{4131}{14} = 29\,5$ tons,

giving 30 tons

60 External volume $= \left(3\frac{3}{4} \times 2\frac{7}{12} \times 1\frac{1}{6}\right)$ cu ft $= \frac{1087}{96}$ cu ft

$= 11\,302$ cu ft

Since 1 gal of water occupies $\frac{10}{623}$ cu ft, 38 gals occupy $\frac{10}{623} \times 38$ cu ft

interval volume $= \frac{10 \times 38}{623}$ cu ft $= 6\,099$ cu ft,

whence volume of stone $= (11\,302 - 6\,099)$ cu ft $= 5\,203$ cu ft

Now 5 203 cu ft of stone weigh 874 lbs,

and 5 203 cu ft of water weigh $5\,203 \times 62\,3$ lbs

req^d number of times $= \frac{874}{5\,203 \times 62\,3}$

$= \frac{874}{324}$

$= 2\,69 = 2\,7$

5	203
6	23
312	0
10	4
1	6
324	0

$$324 \overline{)874} \quad 2\,69$$

226

32

61 Let £x be the req^{d} sum The Amt of £x for 3 yrs $=£x\times(1\cdot03)^3$ (See Art 313)

The respective Amts of the £100 payments are

$$£100\times(1\cdot03)^2,\ £100\times(1\cdot03) \text{ and } £100$$

Thus the total payment $=£x\times(1\cdot03)^3+£100(1\cdot03^2+1\cdot03+1)$

Similarly if he paid £150 a year, the total payment would be $£150(1\cdot03^2+1\cdot03+1)$

$$x\times(1\cdot03)^3+100(1\cdot03^2+1\cdot03+1)=150(1\cdot03^2+1\cdot03+1),$$

or $(1\cdot03)^3x=50(1\cdot03^2\times1\cdot03+1)=50(1\cdot0609+1\cdot03+1)=50\times3\cdot0909$

$$x=\frac{50\times3\cdot0909}{1\cdot03^3}$$
$$=\frac{154\cdot545}{1\cdot092727}$$
$$=141\ 4306$$
$$=£141\ 9s$$

$$1\cdot092727\overline{)154\cdot5450}\ (141\ 4306$$
$$452723$$
$$15632$$
$$4705$$
$$334$$

62 Let x years be his present age, his total salary for 13 years after he was 20 was

Rs $(1000\times3+1200+1400+1600+1800+2000+2200$
$+2400+2600+2800+3000)$,

or Rs 24000 The no of years his salary is stationary will be $(x-13-20)$, or $x-33$ During this time he receives Rs 3000 a year But his salary during this whole period, $(x-20)$ years, averaged Rs 2500

$24000+3000(x-33)=2500(x-20)$, and dividing by 500,

$48+6(x-33)=5(x-20)$, whence $x=50$

63 $3425=5^2\ 137$, $1829=31\times59$, $3245=5\ 11\ 59$

Let x be the third given number

Thus the candidate found the L C M of

$$5\ 11\ 59,\ 31\ 59 \text{ and } x, \qquad (1)$$

instead of the L C M of

$$5^2\ 137,\ 31\ 59 \text{ and } x \qquad (2)$$

As the L C M for (1) and (2) was the same, x must have had as factors

11, which does not occur in (2),

5^2 and 137, which do not occur in (1),

also 2, since x is an even number

x must be a multiple of $2\ 5^2\ 11\ 137$, or 75350
But 75350 is the only 5 figure multiple of 75350,
the third given number $=75350$

64 1 interval on the first $=\frac{3\ 3}{1\ 0}$ in, on the second $=\frac{2\ 7}{8}$,

req^d diff $=\left(\frac{2\ 7}{8}-\frac{3\ 3}{1\ 0}\right)$ in $=\frac{0\ 3}{4\ 0}$ in $=\frac{3}{4\ 0\ 0}$ in

Shortest distance req^d = L C M of $\frac{2\ 7}{8}$ in and $\frac{3\ 3}{1\ 0}$ in,
or $\frac{1\ 3\ 5}{4\ 0\ 0}$ in and $\frac{1\ 3\ 2}{4\ 0\ 0}$ in

This L C M $=\frac{5\ 9\ 4\ 0}{4\ 0\ 0}$ in $=14\frac{1\ 7}{2\ 0}$ in

65 We have 35 ft $=\frac{3\ 5\times 3\ 2}{1\ 0\ 5}$ m $=\frac{3\ 2}{3}$ m Similarly 4 ft $=\frac{1\ 2\ 8}{1\ 0\ 5}$ m

Since the depth is the same in each case, if x gals are contained in the first trench,

$$\frac{x}{2400}=\frac{48\times 2}{\frac{32}{3}\times\frac{128}{105}},\ \text{or}\ x=\frac{48\times 2\times 3\times 105\times 2400}{32\times 128}$$

Now 1 gal $=8$ pints $=\frac{4}{7}\times 8$ litres,

req^d no of litres $=\frac{4\ 8\times 2\times 3\times 1\ 0\ 5\times 2\ 4\ 0\ 0}{3\ 2\times 1\ 2\ 8}\times\frac{4\wedge 8}{7}=81000$

66 Suppose B walks 1 mi. in x min When they meet, B has walked $5\frac{1}{2}$ mi in $5\frac{1}{2}x$ min, A has walked $3\frac{1}{2}$ mi in $3\frac{1}{2}\times 18$ min
These times differ by 3 min, $5\frac{1}{2}x=3\frac{1}{2}\times 18+3$, and $x=12$
B's speed is 1 mi in 12 min, or 5 mi per hr

67 Suppose B, instead of supplying the £500 later on, supplied £100x at the beginning Then, since the time is the same in each case, A's proportion of the profits would be

$$\frac{1100}{1100+(1300+100x)+1700}\ (\text{see Art } 281),\ \text{or}\ \frac{11}{41+x}$$

$\frac{11}{41+x}$ of £2513$\frac{7}{10}$ = £623$\frac{7}{10}$, or $\frac{11}{41+x}=\frac{6237}{25137}\left(\text{or}\ \frac{33}{133}\right)$,

$$\frac{41+x}{11}=\frac{133}{33},\ \text{and}\ x=3\tfrac{1}{3}\qquad 100x=333\tfrac{1}{3},$$

so that B would have supplied £333$\frac{1}{3}$ at the beginning

Now £333$\frac{1}{3}$ lent for 12 months = £500 lent for $\frac{12\times 333\frac{1}{3}}{500}$ months,
or 8 months Hence req^d time is 4 months later

68 15 lbs. per 1 sq in $=15\times7000$ grs per $\frac{1}{(39\cdot37)^2}$ sq m

$=\frac{15\times7000}{15\cdot43}$ gm per $\frac{1}{(39\cdot37)^2}$ sq m $=\frac{15\times7000\times(39\cdot37)^2}{15\cdot43}$ gm per 1 sq m.

$=\frac{15\times7000\times(39\cdot37)^2}{15\cdot43\times1000}$ Kg per 1 sq m

$=\frac{15\times7000\times(39\cdot37)^2}{15\cdot43\times1000\times100}$ Kg per 100 sq cm

$=\frac{105\times1519\cdot9969}{1513}$ Kg per 100 sq cm

$=105\times1\cdot0045$ Kg per 100 sq cm

$=105\cdot47$ Kg per 100 sq cm

excess $=5\cdot47$ in 100, or $5\cdot5\%$

69 Let his income for 1900 be £x, then his income for 1901 $=£x\times\frac{9}{10}$, and therefore his income for 1902 $=£x\times\frac{9}{10}\times\frac{9}{10}$ Hence his expenditure for 1902 is $x\times\frac{9}{10}\times\frac{9}{10}\times\frac{5}{4}$

$$x\times\tfrac{9}{10}\times\tfrac{9}{10}\times\tfrac{5}{4}=x+50 \quad \text{and} \quad x=£4000$$

70 Let req^{d} price per gallon be £x Outlay $=10s\times200=£100$

£100 amounts to £$100\times(1\cdot05)^4$ (see Art 313)

$$175x=100\times(1\cdot05)^4,$$

and $x=\frac{100\times(1\cdot05)^4}{175}=\frac{100\times(1\cdot1025)^2}{175}=\frac{100\times1\cdot21550625}{175}=\frac{4\times1\cdot21550625}{7}$

$=£0\cdot69316=13s\ 11d$

71 In 1 cu cm of the mixture, there are 0·7 cu cm of sulphuric acid and 0·3 cu cm of water Thus weighs

$(0\cdot7\times1\cdot842+0\cdot3\times1)$ gm, or $1\cdot5894$ gm

Hence 1 cu cm of mixture weighs (1) $1\cdot5894$ gm, (2) $1\cdot615$ gm,

1 gm occupies (1) $\frac{1}{1\cdot5894}$ cu cm (2) $\frac{1}{1\cdot615}$ cu cm,

thus loss of volume $=\left(\frac{1}{1\cdot5894}-\frac{1}{1\cdot615}\right)$ cu cm in $\frac{1}{1\cdot5894}$ cu cm

$=\frac{1\cdot615-1\cdot5894}{1\cdot5894\times1\cdot615}$ cu cm in $\frac{1}{1\cdot5894}$ cu cm

$=\frac{0\cdot0256}{1\cdot615}$ cu cm in 1 cu cm

$=\frac{2\cdot56}{1\cdot615}$ per cent, or $1\cdot585\%$

72 Since the course is 1760×3 yds, or 5280 yds, the second man will have run $\frac{30}{32}$ of 5280 yds, or 4950 yds, the third will have run $\frac{22}{32}$ of 5280 yds, or 3630 yds Now

$4950=528\times10-330$, and $3630=528\times7-66$,

giving as answer 330 yds and 66 yds respectively, from the starting point

73 His net income=Rs 1550 − Rs 140=Rs 1410 Rs 1410 is interest on Rs 28000, giving Rs $\frac{141}{28}$ per Rs 100, or 5 04 %

For second part of question, net income

$$=\text{Rs } 1410-\frac{2\frac{1}{2}}{100}\text{ of Rs } 1550=\text{Rs } 1371\ 25$$

Now Rs 1371 25 interest on Rs 28000=Rs $\frac{1371\ 25}{280}$ interest on Rs 100

Now $\frac{1371\ 25}{280}=\frac{34\ 28125}{7}=4\ 897$, giving 4 90 %

74 234 mi cost £1 642, $234\times1760\times0\ 9144$ m cost $1\ 642\times25\ 17$ fr, or $234\times1\ 76\times0\ 9144$ Km cost $164\ 2\times25\ 17$ c,

$$1\text{ Km costs }\frac{164\ 2\times25\ 17}{234\times1\ 76\times0\ 9144}\text{ c}$$

log numerator $=\log 164\ 2+\log 25\ 17=2\ 2153+1\ 4009=3\ 6162$,

log denominator $=\log 234+\log 1\ 76+\log 0\ 9144$

$=2\ 3692+0\ 2455+\bar{1}\ 9611=2\ 5758$,

log fraction $=3\ 6162-2\ 5758=1\ 0404$,

and fraction $=10\ 97$ (centimes per Km)

Alter As above we get 1 Km costs $\frac{164\ 2\times25\ 17}{234\times1\ 76\times0\ 9144}$ c

This $=\frac{4132\ 9}{376\ 58}$

$=10\ 97$ (centimes per Km)

2517	2 34
1 642	1·76
2517	2 34
1510·2	1 63 8
100 68	14 04
5 03	4 11 84
4132 91	0 91 44
37659) 413291 (10 97	3 70 65 | 6
36701	4 11 | 8
2808	1 64 | 7
	16 | 4
	3 76 58 | 5

75 Take a scale of 0 1″ to 5 min horizontally and 0 1′ to 2 miles vertically Assume P is at the origin Join the origin to the point (60, 40), and we obtain the graph of the motor car The train goes at the rate of 1 mile per minute Join the points (15, 0) and (25, 10), and produce this line as far as the point (50, 35) (This will be the graph of the train as far as

the first stopping place) Join the points (50, 35) and (55, 35) by a horizontal line (This will be the train's graph while waiting at the station) Again join the points (55, 35) and (100, 80) (This will be the graph of the train after leaving the station)

(i) It will be seen that when both are in motion, the train and motor-car are together 30 miles from P and 40 miles from P

(ii) At the point on each graph where the ordinate is 150, the abscissae are 170 and 225 respectively Thus the req^{d} length of time is (225 − 170) min or 55 min

76. After the first replacement,

there are $(a-b)$ gals of spirit out of the a gals of the mixture,

the quantity of spirit is $\frac{a-b}{a}$ of the whole mixture, or $\frac{a-b}{a}$ of a gals

Also, since the water and spirit are supposed to be mixed *uniformly*, the amount of spirit *in any quantity of the mixture* is $\frac{a-b}{a}$ of that quantity

when b gals are taken out of the mixture,

$\frac{a-b}{a}$ of b gals of spirit are removed.

$$\text{spirit left} = \left(\frac{a-b}{a} \text{ of } a - \frac{a-b}{a} \text{ of } b\right) \text{ gals}$$

$$= \frac{a-b}{a} \text{ of } (a-b) = \frac{(a-b)^2}{a} = a \times \left(\frac{a-b}{a}\right)^2$$

[If the student finds any difficulty in the above solution, let him put $a=5$ and $b=2$, and then work through the question with these values]

77 A, B and C together do $\frac{1}{60}$ of the work in 1 day,

they do $\frac{1}{60} \times 10$, or $\frac{1}{6}$ of the work in 10 days, and $\frac{5}{6}$ of the work remains to be done

Now C does $\frac{1}{120}$ of the work in 1 day

After A's withdrawal he works for 20 days,

and after B's withdrawal he works for $96(1+\frac{1}{3})$, or 128 days,

he works for (20 + 128), or 148 days, and does $\frac{148}{120}$ or $\frac{2}{3}$ of the work

Thus B, after A's withdrawal, must have done $(\frac{5}{6} - \frac{2}{3})$ of the work, or $\frac{1}{6}$ of the work in 20 days,

he would do the whole work alone in 20×6, or 120 days

78 Let req^{d} sum be £P and r the rate per cent

The Amt on £P at C I for 2 years at r per cent

$$= P\left(1+\frac{r}{100}\right)^2 \quad \text{(See Art 313)}$$

the C I on £P for 2 years at r per cent $= P\left(1+\frac{r}{100}\right)^2 - P$

$$= \frac{2Pr}{100} + \frac{Pr^2}{100^2}$$

Now the S I on £P for 2 years at r per cent $= \frac{2Pr}{100}$

diff of C I and S I for 2 years $= \frac{2Pr}{100} + \frac{Pr^2}{100^2} - \frac{2Pr}{100} = \frac{Pr^2}{100^2}$

$= 13s\ 4d$, or $£\frac{2}{3}$

Similarly,

the C I on £P for 3 years at r per cent $= P\left(1+\frac{r}{100}\right)^3 - P$

$$= \frac{3Pr}{100} + \frac{3Pr^2}{100^2} + \frac{Pr^3}{100^3}$$

Now S I on £P for 3 years at r per cent $= \frac{3Pr}{100}$

diff of C I and S I for 3 years $= \frac{3Pr}{100} + \frac{3Pr^2}{100^2} + \frac{Pr^3}{100^3} - \frac{3Pr}{100}$

$$= \frac{3Pr^2}{100^2} + \frac{Pr^3}{100^3}$$

$= £2\ 0s\ 4d$, or $£2\frac{1}{60}$

We have to solve $\frac{Pr^2}{100^2} = \frac{2}{3}$, (1)

and $\frac{3Pr^2}{100^2} + \frac{Pr^3}{100^3} = 2\frac{1}{60}$ (2)

Substituting from (1) in (2) we get

$$3 \times \frac{2}{3} + \frac{Pr^3}{100^3} = 2\frac{1}{60}, \text{ or } \frac{Pr^3}{100^3} = \frac{1}{60} \quad (3)$$

Divide (3) by (1), then $\frac{r}{100} = \frac{1}{40}$, and $r = 2\ 5$

Substituting in (1) this value for r, $\frac{P \times (2\ 5)^2}{100^4} = \frac{2}{3}$,

and $P = £1066\frac{2}{3} = £1066\ 13s\ 4d$

79 $\sqrt{25+\sqrt{125}}$
$=\sqrt{25+11\ 1803399}$
$=\sqrt{36\ 1803399}$
$=6\ 015$

	1,25,(11 1803399		36,18,03 39,9(6 015	
21	25	1201	18 03	
221	100	12015	60239	
2228	17900		164	
2236,0,3	760000			
	89191			
	22110			
	2076			

80 Let Rs $7x$ and Rs $5x$ be the respective capitals
The elder now has Rs $7x\times(1+\frac{3}{10})$, or Rs $10x$, the younger Rs $(5x-707)$

$$\frac{5x-707}{10x}=\frac{43}{100},\ \text{or}\ 50x-7070=43x,$$

$x=1010$ Hence the elder has Rs 7070, the younger Rs 5050

81 Req^d weight $=(1054\times820\times0\ 8\times11\ 35)$ gm
$=(861280\times9\ 08)$ gm
$=7848$ Kg

861	28
	9 08
7778	5
69	1
7847	6

82 £1 17s 5½d = £1 872 91666 = value of 1 cwt

	10	3		
	187 291	66	= value of 100 cwt	
	5 618	75	= „	3 cwt
14 lbs = ¼ cwt	234	11	= „	14 lbs
7 lbs = ½ of 14 lbs	117	05	= „	7 lbs
3½ lbs = ½ of 7 lbs	058	52	= „	3½ lbs
2 lbs = ⅛ of 14 lbs	033	41	= „	2 lbs
	193 353	53	= total value	

= £193 7s 1d

83 Take 12 o'clock at the origin, and 0 2″ to 1 min horizontally
Take 1″ to 5 miles vertically Plot the points given in the table and join them successively by straight lines It will be seen that the speed is greatest between 5 and 10 miles from the start, since between these two points the graph has its greatest *slope* or *gradient* It then travels 5 miles in 5 min, or 60 miles per hour

84. (20 − 5) rolls cost Rs 90 − Rs 70, or 15 rolls cost Rs 20
Hence 5 rolls cost Rs $\frac{20}{3}$
But gramophone and 5 rolls cost Rs 70,
gramophone costs Rs $63\frac{1}{3}$
gramophone and 50 rolls cost Rs $63\frac{1}{3}$+Rs $66\frac{2}{3}$, or Rs 130

85 (i) 2 204 lbs = 1 Kg, or 2 204 × 16 oz = 1 Kg

1 oz = $\frac{1}{16 \times 2\ 204}$ Kg = $\frac{0\ 4537\ 05}{16}$ Kg = 0 0283575 Kg

= 28 3575 gm

But 1 oz = $\frac{85}{3}$ gm = 28 3333 gm

error is (28 3575 − 28 3333) in 28 3333, or 0 0242 in 28 3333,

req^{d} percentage = $\frac{42 \times 100}{28\ 3333}$ = 0 085, or 0 09 %

(ii) 1 lb = $\frac{1}{2\ 204}$ Kg = 0 4537205 Kg correctly

1 lb = $\frac{5}{11}$ Kg = 0 4545455 Kg roughly

As in (1), we find error is 0 000825 in 0 4537205

req^{d} percentage is $\frac{82\ 50 \times 100}{4\ 53\ 72\ 05}$, or 0 18 %

86 A produces $\frac{224}{132}$ lb = $\frac{19}{110}$ = 0 172 lb

B „ $\frac{139}{794\frac{1}{2}}$ lb = $\frac{278}{1589}$ = 0 175 lb

C „ $\frac{12}{61}$ lb = 0 197 lb

D „ $\frac{112}{632}$ lb = $\frac{14}{79}$ = 0 177 lb

E „ $\frac{20\frac{1}{4}}{118}$ lb = $\frac{81}{472}$ = 0 172 lb

C produces the most butter per gallon, then follow in order of merit D, B, A, E

87 Converting to cm and gm,

req^{d} thickness = $\frac{1\cdot 47000}{1000 \times 100 \times 11\ 4}$ cm = $\frac{1\cdot 47000}{1\ 14000}$ cm = 7 4 mm

88 The respective *rates* of interest are as 1 2 3

Then the total respective interests are as 1 4 9, giving respectively $\frac{1}{14}$, $\frac{4}{14}$ and $\frac{9}{14}$ of Rs 2450

89 In every hour the minute hand traverses 60 minute spaces, while the hour-hand traverses $2\frac{1}{2}$ of such spaces Thus in every 60 min of time the minute hand will gain $57\frac{1}{2}$ minute spaces on the hour-hand, it will therefore gain 15 minute spaces in $15 \times \frac{60}{57\frac{1}{2}}$, or $15\frac{15}{23}$ min of time past noon

The hands will first be together after 1 o'clock when the minute hand has gained $2\frac{1}{2}$ min on the hour-hand, *i e* in $2\frac{1}{2} \times \frac{60}{57\frac{1}{2}}$, or $2\frac{14}{23}$ min past one

90 Since they all *alter their speeds proportionally*, there will be no difference in *the respective positions* of the runners at the end of the different races, *whatever these speeds may be* Hence in our calculation we need take no account of the ratio 7 8 9

Now A runs 100 yds while B runs 96 yds,
and A „ 429 yds „ C „ 440 yds,
A runs 429×100 yds, while B runs 96×429 yds, and C runs 440×100 yds,
B runs 96×429 yds while C runs 440 yds,
B runs $4 \times 96 \times 429$, or 1647 36 yds while C runs 1760,
C can beat B by 112 64 yds

91 Cost of digging per sq ft of surface $= \frac{12}{12} d = d$
Cost of rubble „ „ $= \frac{10}{12} \times \frac{18}{12} d = \frac{1}{2} d$
Cost of gravel „ „ $= \frac{7}{12} \times \frac{30}{12} d = \frac{35}{144} d$
Cost of rolling „ „ $= \frac{6}{12} d$
total cost per sq ft. of surface $= \left(\frac{4}{4} + \frac{1}{2} + \frac{35}{144} + \frac{6}{12}\right) d = \frac{265}{144} d$
total cost for the whole surface $= \frac{265}{144} d \times 880 \times 3 \times 36$
$= 145200 d = £605$

92 Value of total coinage $= £19198815$

Percentage of gold $= \frac{£18398000}{£19198815} \times 100$
$= 96\,8$

Percentage of silver $= \frac{£510490}{£19198815} \times 100$
$= 2\,66$

Percentage of bronze $= \frac{£100325}{£19198815} \times 100$
$= 0\,52$

```
          96 8
192 ) 18588
      1308
       156

           2 66
1920 ) 5105 (
       1265
        113

           0 52
1920 ) 1003 3
        433
         49
```

93 Cash received on sale $= £\left(\frac{95\frac{1}{2}}{100} \text{ of } 850 + \frac{105\frac{1}{4}}{100} \text{ of } 1300\right)$
$= £\left(\frac{191}{4} \times 17 + \frac{421}{4} \times 13\right) = £\frac{8720}{4} = £2180$
Stock bought at $272\frac{1}{2} = £\frac{2180 \times 100}{272\frac{1}{2}} = £\frac{2180 \times 200}{545} = £800$,
total brokerage $= \frac{1}{800}$ of $£(850 + 1300 + 800) = £\frac{2950}{800}$
$= £\frac{59}{16} = £3\ 13s\ 9d$

94 Let Rs r be his outlay on each sword his total outlay is Rs $2000r$, and, since he gains 15 %, his total receipts would be Rs $2000r \times \frac{115}{100}$ But he sells each sword at Rs $12\frac{15}{16}$, and there are $(\frac{95}{100} \times 2000)$ swords

$$2000x \times \tfrac{115}{100} = \tfrac{95}{100} \times 2000 \times 12\tfrac{15}{16},$$

$$\text{and } x = \tfrac{95 \times 2000 \times 207 \times 100}{100 \times 16 \times 2000 \times 115} = \text{Rs } 10\tfrac{11}{16}$$

Now $\frac{35}{100}$ of 2000, or 700 swords, prove worthless

his total receipts are Rs $(12\frac{15}{16} \times 1300)$, or Rs $16818\frac{3}{4}$

But his total outlay is Rs $(10\frac{11}{16} \times 2000)$, or Rs 21375,

his loss = Rs $(21375 - 16818\frac{3}{4})$ = Rs 4556 4a

95 By calculation we obtain the following table

Year	1850	1860	1870	1880	1890	1900
Popⁿ	5000	5400	5940	6702	7641	8787

Take scales of 1″ to 10 years horizontally and 1″ to 1000 population vertically Take the point (1850, 5000) as origin Plot the points as in Art 259, Ex It will be seen that a smooth curve can be drawn through them, and the required results may then be read off

	5000
Add 8 %	400
	5400
Add 10 %	540
	5940
Add 10 %	594
,, 3 %	178 2
	6702 2
Add 10 %	670 22
,, 4 %	268 088
	7640 5
Add 10 %	764 05
,, 5 %	382 025
	8786 575

96 See Art 313

Last July's payment of Rs 1000 will amount to
Rs $1000 \times (1\ 025)^3$ by next January

This year's January payment of Rs 1000 will amount to
Rs $1000 \times (1\ 025)^2$ by next January

This year's July payment of Rs 1000 will amount to
Rs $1000 \times (1\ 025)$ by next January

Next January's payment will be Rs 1000

total payment due next January

= Rs $1000 \times (1\ 025)^3$ + Rs $1000 \times (1\ 025)^2$ + Rs $1000 \times (1\ 025)$ + Rs 1000

= Rs 1076 8906 + Rs 1050 625 + Rs 1025 + Rs 1000

= Rs 4152 5156 = Rs 4152 8a 3p

97 Let req^{d} distance be x Km

From A to B I ride $(x-\frac{3}{4})$ Km, and take $\frac{x-\frac{3}{4}}{15\frac{3}{4}}$ hrs,

I walk $\frac{3}{4}$ Km, and take $\frac{\frac{3}{4}}{4\frac{1}{2}}$, or $\frac{1}{6}$ hrs

From B to A I ride x Km, and take $\frac{x}{15}$ hrs

$$\frac{x-\frac{3}{4}}{15\frac{3}{4}}+\frac{1}{6}=\frac{x}{15}, \quad \text{or} \quad \frac{4x-3}{63}+\frac{1}{6}=\frac{x}{15},$$

$i.e.$ $10(4x-3)+105=42x$, whence $x=37\cdot5$ Km

98 The L C M of 221 and 364 $=2912$

In 2912 secs after starting A and B arrive for the first time at the starting point In this time A will have gone round 13 times and B 8 times, A passes B 5 times

99

1 031	485	1 063	96
	1 031485		1 031485
1·031	49	1 063	96
30	95	31	92
1	03	1	06
	41		43
	8		9
1 063	96	1 097	46

100 Req^{d} area $=127\cdot35\times98\cdot27$ sq m

$$=\frac{127\cdot35\times98\cdot27}{(0\cdot9144)^2}\text{ sq yds}$$

$$=\frac{127\cdot35\times98\cdot27}{(0\cdot9144)^2\times4840}\text{ ac}$$

$$=\frac{12\cdot735\times0\cdot9827}{0\cdot83613\times4\cdot84}\text{ ac}$$

12 735		0 836	13
982	7	4 81	
11 461	5	3 344	5
1 018	8	668	9
25	5	33	4
8	9	4 046	8
12 514	7		

$$4047\overline{)12514}\,(3\cdot09$$

$$373$$

101 1st year's dividend $= \frac{\text{Rs } 3 \times 10000}{105} = \frac{\text{Rs } 2000}{7}$

2nd year's dividend $= \frac{\text{Rs } 2000}{7} + \frac{\text{Rs } 3 \times 2000}{107 \times 7} = \frac{\text{Rs } 2000}{7}\left(1 + \frac{3}{107}\right)$

$= \frac{\text{Rs } 2000 \times 110}{7 \times 107}$

3rd year's dividend $= \frac{\text{Rs } 2000 \times 110}{7 \times 107} + \frac{\text{Rs } 3 \times 2000 \times 110}{108 \times 7 \times 107}$

$= \frac{\text{Rs } 2000 \times 110}{7 \times 107}\left(1 + \frac{3}{108}\right) = \frac{\text{Rs } 2000 \times 110 \times 111}{7 \times 107 \times 108}$

$= \frac{\text{Rs } 2035000}{6741} = \text{Rs } 301 \ 14\text{a } 3\text{p}$

102 By investing Re 1 the respective interests received are Re 037, Re 036, Re 030, Re 046, and Re 042

the stocks arranged in relative order of merit as profitable investments stand thus —Bank of Madras, Bank of Bengal, Govt Paper (3), Govt Paper ($3\frac{1}{2}$), and Govt Consols

By investing Rs 97 3 the net interest received is Rs $3\frac{1}{2} \times \frac{187}{10 \times 12}$

by investing a lac of rupees the net interest received is

$$\text{Rs } \frac{100000}{973} \times \frac{7}{2} \times \frac{187}{10 \times 12} = \text{Rs } 3503 \ 7\text{a}$$

103 Since 27 gals $= 216$ pints, there are $215\frac{1}{2}$ pints left after 1st day

216 pints are reduced to $215\frac{1}{2}$, or 1 pint to $\frac{215\frac{1}{2}}{216}$ pints

Thus the multiplying ratio (see Arts 269–271) is $\frac{215\frac{1}{2}}{216}$ for each day

after 20 days $216 \times \left(\frac{215\frac{1}{2}}{216}\right)^{20}$, or $216 \times \left(\frac{431}{432}\right)^{20}$ pints remain

104 Req^{d} no $= 16 \times \frac{60 \text{ secs}}{10 \text{ secs}} \times \frac{5 \text{ teeth}}{24 \text{ teeth}} = \frac{16 \times 60 \times 5}{10 \times 24} = 20$

105 Suppose d_1 inches fell in 1899, d_2 in 1900, etc

Then $d_1 + d_2 + d_3 = 74\ 94$, *i e* $(24\ 98 \times 3)$, (1)

$d_4 + d_5 + d_6 = 88\ 86$, *i e* $(29\ 62 \times 3)$, (2)

$-d_4 + d_5 = 4\ 80$, (3)

$d_5 - d_6 = 6\ 36$, (4)

$-d_2 + d_5 = 7\ 47$, (5)

$d_2 - d_3 = 0\ 17$ (6)

Adding (2), (3) and (4), $3d_5 = 100\cdot2$ and $d_5 = 33\cdot34$ in
Subst for d_5 in (4) we find $d_6 = 26\cdot98$ in
Subst for d_4 in (3) we find $d_4 = 28\cdot54$ in
Subst for d_3 in (5) we find $d_2 = 25\cdot87$ in
Subst for d_2 in (6) we find $d_3 = 25\cdot70$ in
Subst for d_2 and d_3 in (1) we find $d_1 = 23\cdot37$ in

106 Let req^d length be x yds
A runs x yds while B runs $(x-15)$ yds and C runs $(x-29)$ yds (1)
Again B runs x yds while C runs $(x-15)$ yds (2)

From (1), $\frac{B\text{'s rate}}{C\text{'s rate}} = \frac{x-15}{x-29}$, from (2), $\frac{B\text{'s rate}}{C\text{'s rate}} = \frac{x}{x-15}$

$$\frac{x-15}{x-29} = \frac{x}{x-15}$$ Multiply by $(x-29)\times(x-15)$,

$(x-15)\times(x-15) = x(x-29)$, or $x^2-30x+225 = x^2-29x$
Subtract x^2 from each side, then $-30x+225 = -29x$, and $x = 225$

107 Req^d value $= \frac{£2000\times4\frac{1}{2}}{114\frac{1}{2}} \times \frac{229}{240}$ (see Ex XVI d, No 21)

$$= \frac{£2000\times9\times229}{229\times240} = \frac{£600}{8} = £75$$

108 The 'remainder' $= 1-\frac{1}{3}-\frac{3}{5} = \frac{1}{15}$

his total profit $= \frac{14}{100}$ of $\frac{1}{3} + \frac{17\frac{1}{2}}{100}$ of $\frac{3}{5} + \frac{20}{100}$ of $\frac{1}{15}$

$$= \frac{14}{300} + \frac{21}{200} + \frac{4}{300} = \frac{99}{600} = \frac{16\frac{1}{2}}{100}$$, giving $16\frac{1}{2}$ % profit

109 Let £x be his capital at first 7 months' interest at $3\frac{3}{4}$ % is £$\frac{7}{12}$ of $\frac{3\frac{3}{4}x}{100}$, capital + interest $= £\left(x + \frac{7\times3\frac{3}{4}x}{1200}\right) = £\frac{327}{320}x$

He then invests £$\frac{327}{320}x$, after six months he draws a dividend of £$\frac{1}{2}$ of $\frac{3}{109}$ of £$\frac{327}{320}x$ and realises by sale £$\frac{106\frac{1}{2}}{109}$ of $\frac{327}{320}x$

the total return $= £\left(\frac{1}{2}\times\frac{3}{109}\times\frac{\overset{3}{\cancel{327}}}{320}x + \frac{106\frac{1}{2}}{\cancel{109}}\times\frac{\overset{3}{\cancel{327}}}{320}x\right)$

$$= £\frac{3}{320}(1\tfrac{1}{2}+106\tfrac{1}{2})x = £\frac{81}{80}x,$$

net gain on £x = £$\frac{x}{80}$, giving $1\frac{1}{4}$ % gain

110 A puts in 126 oxen for 3 months, which costs him as much as 126×3 oxen for 1 month Similarly the cost to B and C is that of 162×5 oxen and 72×12 oxen respectively for 1 month

Thus their expenses are as 126×3 162×5 72×12, or as 7 15 16

Thus A pays $\frac{7}{38}$ of Rs 570, B pays $\frac{15}{38}$ of Rs 570, C pays $\frac{16}{38}$ of Rs 570 (see Art 281)

111 Let x be the no of children in town, out of 100 in town and country, then $100-x$ is the number in the country

The total cost is $[69x+39(100-x)]$ pence it is also 60×100 pence

$$69x+39(100-x)=6000, \text{ and } x=70$$

Thus req^{d} percentages are 70 and 30

112 The bookseller contributed Rs 8000 for 366 days

His partner contributed Rs 11500 for 108 days

their shares are as 8000×366 11500×108, *i e* as 488 207

Thus the bookseller receives $\frac{488}{695}$ of Rs 1654

$=488\times$ Rs 2 3799 $=$ Rs 1161 6 a.

His partner receives $\frac{207}{695}$ of Rs 1654

$=207\times$ Rs 2 3799 $=$ Rs 492 10 a

113 Let £x be req^{d} price, then the first bicycle realised £$\frac{60}{100}x$,

the second bicycle cost £$\left(\frac{60x}{100}+5\frac{1}{4}\right)$ and realised

$$\frac{65}{100} \text{ of } £\left(\frac{60x}{100}+5\tfrac{1}{4}\right)$$

The third bicycle was bought with this and the addition of £5 15s 3d, or £$5\frac{61}{80}$,

$$\frac{65}{100}\times\left(\frac{60x}{100}+5\tfrac{1}{4}\right)+5\tfrac{61}{80}=16, \text{ or } \frac{65\times60x}{100\times100}+\frac{65\times21}{100\times4}=10\tfrac{19}{80}$$

Hence $\frac{39x}{100}+3\frac{33}{80}=10\frac{19}{80}$, or $\frac{39x}{100}=6\frac{33}{40}$, and $x=$£$17\frac{1}{2}$

114 1 m $=3\cdot28$ ft, 1 sq m $=(3\cdot28)^2$ sq ft

Hence 1 are $=(3\cdot28)^2\times100$ sq ft

and 1 Ha $=(3\cdot28)^2\times100\times100$ sq ft

$=\frac{3\cdot28\times3\cdot28}{4840\times9}$ ac

$=\frac{41\times328}{605\times9}$ ac $=\frac{13448}{5445}$ ac

$=2\cdot470$ ac nearly

$$5445\overline{)13448}\ (2\cdot4698$$

25580

3800

533

43

115 True area $= 4 \times 3\ 14159 \times (4000)^2$ sq mi

Approx area $= 4 \times 3\ 142857143 \times (4000)^2$ sq mi $\left[\frac{22}{7} = 3\ 142857143\right]$

Difference $= 4 \times 4000^2 \times 0\ 001267143$ sq mi

$= 4 \times 4^2 \times 1267\ 143$ sq mi

$= 64 \times 1267\ 143$ sq mi

$= 81097$ sq mi (more)

1267	143
6	4
76028	4
5068	6
81097	0

116 The company has to pay back altogether the Amt of Rs 1658775 at 4 % C I

This $=$ Rs $1658775 \times (1\ 01)^4$ (see Art 313)

$=$ Rs $1658775 \times (1\ 0816)^2$

$=$ Rs $1658775 \times 1\ 16985856$

$=$ Rs 1940532

1658775	
1	16985856
1658775	
165877	5
99526	50
14928	98
1327	02
82	94
13	26
	83
	10
1940532	13

Since they pay by annual instalments of Rs 156976, the first instalment paid at the end of the first year amounts to Rs $456976 \times (1\ 01)^3$ in 3 more years at 4 % C I

Similarly the second instalment paid at the end of the second year amounts to Rs $456976 \times (1\ 04)^2$ in 2 more years at 4 % C I

In the same way the third instalment amounts to Rs $456976 \times 1\ 04$ at the end of the time

With the last instalment the payments amount to

Rs $456976(1\ 04^3 + 1\ 04^2 + 1\ 04 + 1)$,

or Rs $456976(1\ 124864 + 1\ 0816 + 1\ 04 + 1)$,

or Rs $456976 \times 4\ 246164$,

or Rs 1940532, as above

456976	
4	246464
1827904	
91395	2
18279	0
2741	8
182	8
27	4
1	8
1940532	0

117 At the rate of $3\frac{1}{2}$ mi per hr, they row 308 ft in 63 secs Since the next gun is fired when they have rowed for 60 secs, it follows that the report takes 3 secs to reach them But in 3 secs, sound travels 1100×3 ft, or 3300 ft

req^d distance $= (308 + 3300)$ ft, or 3608 ft

118 Their times for the whole journey are as 42 56, or as 3 4, their speeds are as 4 3 (see Art 271), and they meet at a point which divides the whole distance in the ratio of 4 3, *i e* they meet at $\frac{4}{7}$ of the distance from Liverpool, and in $\frac{4}{7}$ of 42 min or 24 min

Take 4 in vertically to represent the distance between Liverpool and Manchester Mark the successive inch divisions along the y-axis from the origin inclusive, 0, 1, 2, 3, 4 For time take 1 in to represent 10 min along the x-axis Assume Liverpool to be at the origin Join the origin to the point (42, 4), to obtain the graph of the first train The line joining the points (0, 4) and (56, 0) will be the graph of the second train They cut at the point whose abscissa is 24

119 Let each man do m units of work, and each boy b units of work per day

9 men and 6 boys in 2 days do $(18m+12b)$ units,

5 men and 7 boys in 3 days do $(15m+21b)$ units

But these sets of units are equal,

$$18m+12b=15m+21b, \text{ or } m=3b$$

the work consists of $18m+12b$, or $54b+12b$, or $66b$ units

Again 2 men and 5 boys do $(2m+5b)$ units in 1 day

Now $2m+5b=6b+5b=11b$ since $11b$ units are done in 1 day, $66b$ units will take 6 days

120

	1st Jar contains	2nd Jar contains
At first	8 pints of brandy	8 pints of water
After 1st operation	7 pints of brandy	{8 pints of water, 1 pint of brandy,} or {$\frac{8}{9}$ water, $\frac{1}{9}$ brandy}
After 2nd operation	{$(7+\frac{1}{9})$ pints of brandy, $\frac{8}{9}$ pint of water}	{$(8-\frac{8}{9})$ pints of water, $(1-\frac{1}{9})$ pints of brandy,} or {$(7+\frac{1}{9})$ pints of water, $\frac{8}{9}$ pint of brandy}

121 (1) $\pi=3\frac{1}{7}=\frac{22}{7}$

$$\frac{1}{\pi}=\frac{7}{22}=\frac{560}{1760}=\frac{440+110+10}{1760}=\frac{1}{4}+\frac{1}{10}+\frac{1}{176}$$

$$\frac{576}{\pi}=576\times\frac{1}{\pi}=576\times\left(\frac{1}{4}+\frac{1}{10}+\frac{1}{176}\right)$$

$$\begin{array}{r} 576 \\ \hline 144 \\ 36 \\ 327 \\ \hline 18327 \end{array}$$

$=18\,33$ to two places of decimals

(2) π hours $=3$ hours, 8 minutes, 30 seconds $=3$ hours, $8\frac{1}{2}$ minutes

$$=3\frac{17}{2\times60}=3\frac{17}{120} \text{ hours}=\frac{377}{120}=3\,1416 \text{ hours}$$

$$\pi=(1)\ 3\,1416=(11)\ 3\frac{17}{120}$$

122 Since external diameter $=7\cdot5$ in,
Weight of hollow sphere
$=0\cdot5236(7\cdot5^3-7^3)\times 4\cdot48$ oz
$=0\cdot5236(421\cdot875-343)\times 4\cdot48$ oz
$=0\cdot5236(78\cdot875)\times 4\cdot48$ oz
$=185$ oz.

78	875
	4 48
315	50
31	55
6	31
353	36
	0 5236
176	68
7	07
1	06
	21
185	02

123 Let a third-class ticket cost x pence, then a second class ticket costs $1\frac{1}{2}x$ pence, and a first class ticket costs $1\frac{2}{3}\times 1\frac{1}{2}x$ pence

Now $16s\ 10\frac{1}{2}d = 202\frac{1}{2}d$ $\quad \frac{x}{2}+1\frac{1}{2}x+1\frac{2}{3}\times 1\frac{1}{2}x = 202\frac{1}{2}$,

or $x+3x+5x=405$, and $x=45$
the tickets are $1\frac{2}{3}\times 1\frac{1}{2}\times 45d$, or $9s\ 4\frac{1}{2}d$, etc,
and the rates per mile are $\frac{9s\ 4\frac{1}{2}d}{45}$, or $2\frac{1}{2}d$, etc

124 The req^d number must be odd, since it is a prime

it ends in 9, giving $\left\{\begin{matrix}189,\ 279,\ 369,\ 459\\ 819,\ 729,\ 639,\ 549\end{matrix}\right\}$ as possibilities, (1)

or „ 7, „ $\left\{\begin{matrix}167,\ 257,\ 347\\ 617,\ 527,\ 437\end{matrix}\right\}$ „ (2)

or „ 5, „ $\left\{\begin{matrix}145,\ 235\\ 415,\ 325\end{matrix}\right\}$ „ (3)

or „ 3, „ $\left\{\begin{matrix}123\\ 213\end{matrix}\right\}$ „ (4)

Now every number in (1) is a multiple of 9,
„ „ (3) „ „ 5,
„ „ (4) „ „ 3,
} and cannot be prime

From (2), we find $527=17\times 31$,
and $437=19\times 23$

257 and 347, although both prime, will not satisfy the conditions
We are thus left with 167 and 617, which are both prime

125 He rows at 4 miles an hour on still water
„ $1\frac{1}{3}\times 4$, or $5\frac{1}{3}$ miles an hour down stream,
the stream flows at $1\frac{1}{3}$ miles per hour
He rows up stream at $(4-1\frac{1}{3})$, or $2\frac{2}{3}$ miles per hour

$$\text{req}^d \text{ time} = \left(\frac{1\frac{1}{3}}{2\frac{2}{3}}+\frac{1}{4}\right) \text{hrs} = \frac{3}{4} \text{ hr}$$

126 He has to pay back altogether the amount of Rs 25220 for 3 years at 5 % C I This $=\text{Rs } 25220\times(1\cdot05)^3$ (See Art 313)

Suppose Rs P is the yearly instalment Then Rs P paid at the end of the first year amounts to Rs $P\times(1\cdot05)^2$ in 2 more years at 5 % C I

Similarly Rs P paid at the end of the second year amounts to Rs $P\times1\cdot05$

With the last instalment, the payments settle the debt,

and $P(1\cdot05^2+1\cdot05+1)=25220\times(1\cdot05)^3$

$P\times3\cdot1525=25220\times1\cdot157625$,

and $P=\frac{25220\times1\cdot157625}{3\cdot1525}$

$=\frac{2522\times4\cdot6305}{1261}$

$=\text{Rs } 9261$

4	6305
252	2
9261	0
2315	3
92	6
9	3
1261 | 11678	2 (9261
3292	
769	
12	

127 Suppose x lbs are allowed free to each passenger

When they share the luggage $2x$ lbs are not paid for, and $(345-2x)$ lbs cost them (Rs 3 2a + Rs 5), or $130a$,

$$i.e.\ \frac{345-2x}{13}\text{ lbs cost }10a$$

When one of them owns all the luggage, x lbs are not paid for, and $(345-x)$ lbs cost him Rs 11 4a, or $180a$,

$$i.e.\ \frac{345-x}{18}\text{ lbs cost }10a$$

$\frac{345-2x}{13}=\frac{345-x}{18}$, or $18(345-2x)=13(345-x)$, and $x=75$

128 Let x be the req^d number Expressing cost and receipts in annas, and equating them, we get

$$122x=28x+4800,\text{ and }x=51\tfrac{3}{47}$$

Thus the least possible no of copies is 52

To verify graphically, take scales of 50 rupees to the inch horizontally, and 10 photogravures to the inch vertically Cost of producing 40 photogravures = Rs 370

Join the points (300, 0) and (370, 40), and we obtain the graph for the cost of production of any number of copies Again 40 copies are sold for Rs 305

Join the origin to the point (305, 40), and the graph for the 'sales' is obtained

These graphs will be found to meet at a point whose ordinate lies between 51 and 52 in value

129 When he turns back to the starting point, 10′ has gone He arrives there in 10′ more Since the rest of the party will reach the station 1 hour after they started, he has now to walk 3 miles in 40′, or at the rate of $4\frac{1}{2}$ miles an hour

To verify this result graphically, take 3 in horizontally to represent 1 hour, and 1 in vertically to represent 1 mile

Join the origin to the point (1, 3), and we obtain the graph for the majority of the party Next, join the points $(\frac{1}{6}, \frac{1}{2})$, $(\frac{1}{3}, 0)$ and (1, 3) successively, and we have the graph for the 'one' tourist after he leaves the rest of the party The line joining the two last-mentioned points represents a rate of 3 miles in $\frac{2}{3}$ of an hour, or $4\frac{1}{2}$ miles an hour

130 x miles per hour $= 5280x$ feet per 3600 seconds

$$= \frac{5280x}{3600} \text{ ft per sec.} = \frac{44x}{30} \text{ ft per sec ,}$$

but by the rule we have $\frac{45x}{30}$ „ „

so that on $\frac{44x}{30}$ ft we have an error of $\frac{1}{30}x$ ft ,

i e on 44 „ „ 1,

i e on 100 „ „ $\frac{100}{44} = \frac{25}{11} = 2\,27$,

i e 2 % to the nearest integer

131 Maximum weight of sovereign $= 123\,47447$ grains

Minimum „ „ $= 122\,5$ „

The heap of sovereigns weighs within the limits $384 \pm 5 \times 180$ gr

greatest no of sovs $= \frac{384\cdot5 \times 180}{122\cdot5} = \frac{3845 \times 180}{1225} = 564\,9$,

greatest no of sovs $= 564$

The least no of sovs $= \frac{383\cdot5 \times 180}{123\,47447} = 559\,07$,

least no of sovs $= 560$

132 Let $7x$ be the no of teeth in the first wheel

then $6x$ is „ „ second „

$5x$ „ „ third „

and $4x$ „ „ fourth „

Now L.C.M of $7x$, $6x$, $5x$, $4x$ is $420x$

when $420x$ teeth have passed on each wheel, each will have made an exact number of revolutions, and they will be simultaneously in their original positions

the first must revolve $\frac{420x}{7x}$, or 60 times, etc , etc

133 Rs (6760 − 6500), or Rs 260 is the interest on Rs 6500 for 1 yr

Rs $\frac{260}{65}$ or Rs 4 „ „ Rs 100 „

Thus if Rs P be the req^{d} sum,

$$P(1\cdot04)=6500 \text{ (Art 313)}$$

$$P=\frac{6500}{1\cdot04}=\text{Rs } 6250$$

134 Let req^{d} length be x ft Cost per sq ft $=\frac{11}{9}$s

Then total cost $=x\times6\times\frac{11}{9}s=x\times6\times\frac{11}{9}\times\frac{25\cdot20}{20}$fr

But total cost $=787\cdot4\times1\cdot53\times1\cdot5$ fr

$$x\times6\times\frac{11}{9}\times\frac{25\cdot20}{20}=787\cdot4\times1\cdot53\times1\cdot5,$$

whence $$x=\frac{787\cdot4\times1\cdot53\times1\cdot5\times9\times20}{6\times11\times25\cdot20}=\frac{787\cdot4\times17}{07}$$

$$=\frac{1338\cdot58}{07}=1912 \text{ ft}=637 \text{ yds}$$

135 In the first year profit = Rs (35,40,000 − 25,10,000) = Rs 10,30,000

In the second year receipts $=\frac{96\frac{1}{2}}{100}$ of Rs 35,40,000 = Rs 34,16,100,

„ „ expenses $=\frac{100\frac{1}{2}}{100}$ of Rs 25,10,100 = Rs 25,22,550,

„ „ profit = Rs 8,93,550

Difference of the two years' profits = Rs 1,36,450,

$$\text{req}^{d} \text{ percentage}=100\times\frac{136450}{1030000}=\frac{1364\cdot5}{103}=13\cdot2$$

136 Interest received $=\frac{3}{117}$ of £9000 $+\frac{2\frac{3}{4}}{108}$ of £7200 (1)

Cash realised by sale $=\frac{110\frac{3}{4}}{117}$ of £9000 $+\frac{110\frac{3}{4}}{108}$ of £7200 (2)

Total cash obtained = (1) + (2) $=\frac{113\frac{3}{4}}{117}$ of £9000 $+\frac{113\frac{1}{4}}{108}$ of £7200

Hence req^{d} gain $=\left(\frac{113\frac{3}{4}}{117}-1\right)$ of £9000 $+\left(\frac{113\frac{1}{4}}{108}-1\right)$ of £7200

$=\frac{5\frac{1}{2}}{108}$ of £7200 $-\frac{3\frac{1}{4}}{117}$ of £9000 $=£\left(\frac{1100}{3}-\frac{1000}{4}\right)=£116$ 13s 4d

137 $\sqrt{1\,0090} - \sqrt{0\,091}$

$= 1\,0044 - 0\,3017$

$= 0\,7027 = 0\,703$

$$\begin{array}{r|l} 1,00,90 & (1\,0044 \\ 200,4 & 00\,9000 \\ & \underline{984} \\ 0,09,1 & (0\,30166 \\ 601 & 1000 \\ 6026 & \underline{39900} \\ & 3744 \end{array}$$

138 Let $2n$ workmen be engaged on the first house,
and n „ „ second „
Suppose each is paid Re x per hour
Then the cost per day of the first house

$$= \text{Rs } 10x \times 2n + \text{Rs } 2 \times \frac{3x}{2} \times 2n = \text{Rs } 26nx,$$

and the cost per day of the second house $= 10x \times n = \text{Rs } 10nx$
Again, the first house takes 4 months, or 4×30 days,
and the second „ 7 „ or 7×30 „ ,

$$26nx \times 4 \times 30 + 10nx \times 7 \times 30 = 17400$$

Divide by 30, then $104nx + 70nx = 580$, or $nx = \frac{1}{3}^0$
cost of first house $= \text{Rs } 26nx \times 4 \times 30 = \text{Rs } 10400$,
cost of second house $= \text{Rs } 10nx \times 7 \times 30 = \text{Rs } 7000$

139 Let V_1 be the volume of water, V_2 that of the other liquid
Then V_1 weighs V_1 kilograms, and V_2 weighs $V_2 \times 1\,340$ Kg
The volume of the mixture is $(V_1 + V_2)$,
and this weighs $(V_1 + V_2) \times 1\,270$ Kg
$(V_1 + V_2) \times 1\,270 = V_1 + V_2 \times 1\,340$, or $V_1 \times 0\,27 = V_2 \times 0\,07$,

$$\frac{V_1}{V_2} = \frac{7}{27}$$ Thus $\frac{7}{3^4}$ are water, $\frac{2}{3}\frac{7}{4}$ other liquid

140 Let req^d distance be x miles, which the first train takes 50 min to travel Its rate in miles per min is therefore $\frac{x}{50}$, and at 12 20 it has travelled 20 $\frac{x}{50}$ miles Similarly at 12 20 the second train has travelled 15 $\frac{x}{45}$ miles and the third 10 $\frac{x}{40}$ miles

$$\frac{20x}{50} + \frac{15x}{45} + \frac{10x}{40} = 36\frac{7}{8}, \text{ or } \frac{2x}{5} + \frac{x}{3} + \frac{x}{4} = \frac{295}{8}, \text{ and } x = 37\frac{1}{2} \text{ miles}$$

141 Perimeter of room $=2(a+b)$ ft

Area of walls $=2c(a+b)$ sq ft

Width of paper $=d$ ft

no of yds of paper req$^{d}=\frac{2c(a+b)}{3d}$

Cost of paper $=\frac{2c(a+b)}{3d}\times\frac{n}{16\times 12}$ rupees

$=\text{Rs}\ \frac{nc(a+b)}{288d}$

142 Since 1 md $=40$ srs, after the first replacement, $\frac{7}{8}$ md is milk After the second, $\frac{7}{8}$ of $\frac{7}{8}$, or $(\frac{7}{8})^2$ md is milk Similarly, after the 3rd replacement, $(\frac{7}{8})^3$ md is milk

Now suppose 1 md cost x annas at first

Then $(\frac{7}{8})^3$ md is sold for r annas,

i e 1 md is sold for $(\frac{8}{7})^3\ x$, or $\frac{512}{343}x$ annas

gain on x annas $=(\frac{512}{343}r-1)$ annas $=\frac{169}{343}x$ annas,

gain per cent $=\frac{16900}{343}=49\ 27$

143 (i) Correcting to four significant figures,

the fraction becomes $\frac{52\ 45\times 378\ 4\times 0\ 0209}{87\ 32\times 0\ 584}$

Numerator		Denominator	
log 52 45	$=1\ 7197$		
log 378 4	$=2\ 5780$	log 87 32	$=1\ 9411$
log 0 0209	$=\bar{2}\ 3201$	log 0 584	$=\bar{1}\ 7664$
log *numerator*	$=2\ 6178$	log *denominator*	$=1\ 7075$

log fraction $=2\ 6178-1\ 7075=0\ 9103$,

and antilog $0\ 9103=8\ 134$

(ii) Denote the expression by x, then

$\log x=2\log 1\ 03+4\log 1\ 025+\log 1\ 05$

$=0\ 0256+0\ 0428+0\ 0212=0\ 0896$,

and antilog $0\ 0896=1\ 229$

144 See Art 311 and the note to Ex, Art 313 From this we get

req^{d} Amount $=£500\times(1\ 03)^2\times(1\ 025)^4\times 1\ 05$

$=£500\times 1\ 229=£614\ 5=£614\ 10s$

145 Water in mixture $=(\frac{11}{100}$ of 1 gal $+\frac{7}{100}$ of 3 gals $+\frac{1}{2}$ gal$)$
$=(\frac{11}{100}+\frac{21}{100}+\frac{1}{2})$ gals $=\frac{82}{100}$ gals Also mixture $=4\frac{1}{2}$ gals
Now $\frac{82}{100}$ gals out of $4\frac{1}{2}$ gals $=\frac{82}{4\frac{1}{2}}$ out of 100, or $18\frac{2}{9}$ %

146. 712 lbs weigh more than 1728 cu in
1 lb weighs more than $\frac{1728}{712}$ cu in
If r shot go to the lb,
then their volume $\frac{\pi r^3}{6\ 8^3} > \frac{1728}{712}$ cu in,
i e $r > \frac{1728\times 6\times 8^3}{712\times\pi}$,
or $r > \frac{1728\times 6\times 64}{712\times 3\ 14159}$, or 2373 2

1728 × 6 × 64 = 663552
3 14159 × 89 = 279 60151
2373 2
2 79602) 6635 52
1043 48
204 67
8 95
56

Similarly,
1 lb weighs less than $\frac{1728}{708}$ cu in,
and the volume $\frac{\pi r^3}{6\ 8^3} < \frac{1728}{708}$ cu in,
and $r < \frac{864\times 6\times\pi\times 512}{708\times 3\ 14159}$, or 2386 6

864 × 512 = 442368
3 14159 × 59 = 185 35381
2386 6
1 85354) 4423 68
716 60
160 54
12 26
1 24

Thus r lies between 2373 and 2387

147 2 oz. of bluestone and $1\frac{1}{4}$ oz of lime go to 1 gal or 10 lbs of water,
or 2 oz of bluestone and $1\frac{1}{4}$ oz. of lime go to 160 oz of water,
2 gm of bluestone and $1\frac{1}{4}$ gm of lime go to 160 gm of water,
or $\frac{2000}{160}$ gm of bluestone and $\frac{1250}{160}$ gm of lime go to 1000 c c of water,
i e 12 5 gm of bluestone and 7 81 gm of lime go to 1 litre of water

148 Let r = no of rupees lent
Then $r(1\ 04)^4 - r(1\ 08)^2 = 650$,
i e $r(1\ 16985856 - 1\ 1664) = 650$,
i e $r \times 0\ 00345856 = 650$
$r = 187939$
Principal = Rs 187900 to the nearest hundred

149 Let one man's work in one day represent a unit of work
Since 150 men in 25 days complete $\frac{1}{4}$ of the work,
$150 \times 25 \times 4$, *i e* 15000, units of work are needed for the whole
100 men in 60 days complete $\frac{2}{5}$ of the work
$\frac{7}{50}$ of the work, *i e* 5250 units of work, remain
But $130-(25+60+10)$, *i e* 35, days only remain
$\frac{5250}{35}$, *i e* 150, men are required

150 Let x Rs = cost of goods
Then $\frac{3}{4}$ of stock sells for Rs $\frac{x \times 140 \times 3}{100 \times 4}$
$= \text{Rs } \frac{105x}{100}$
The remaining $\frac{1}{4}$ of the stock sells for Rs $\frac{x \times 140 \times 60}{100 \times 100 \times 4}$
$= \text{Rs } \frac{21x}{100}$
whole stock sells for Rs $\frac{126x}{100}$
gain = 26 %

151 Suppose the man rows x mi an hour on still water, and that the stream flows at y miles per hr
Then he rows up stream at $(x-y)$ mi per hr, and down stream at $(x+y)$ mi per hr
In 18 min, or $\frac{3}{10}$ hr, he rows $\frac{3}{10}(x-y)$ mi up stream He rows this distance down stream at $(x+y)$ mi per hr, and therefore takes $\frac{3(x-y)}{10(x+y)}$ hrs
He rows the last $1\frac{1}{2}$ mi down stream in $\frac{1\frac{1}{2}}{x+y}$ hrs
the total time between his passing and overtaking the bottle
$= \left(\frac{3}{10} + \frac{3(x-y)}{10(x+y)} + \frac{1\frac{1}{2}}{x+y}\right)$, or $\frac{6x+15}{10(x+y)}$ hrs
But this is the time taken by the bottle to float down $1\frac{1}{2}$ mi, *i e* $\frac{1\frac{1}{2}}{y}$ hrs
$\frac{6x+15}{10(x+y)} = \frac{1\frac{1}{2}}{y}$, or $(6x+15)y = 15(x+y)$, *i e* $6xy = 15x$
Divide by x, and $y = 2\frac{1}{2}$

152 Substituting the given values $a=\frac{5000\times(1\cdot03)^{10}\times0\cdot03}{(1\cdot03)^{10}-1}$,

log numerator $=\log 5000+10\log 1\cdot03+\log 0\cdot03$

$=3\cdot6990+0\cdot1280+\bar{2}\cdot4771=2\cdot3041$,

numerator $=$ antilog $2\cdot3041=201\cdot4$

Noting that $10\log1\cdot03=0\cdot1280$, and antilog $0\cdot1280=1\cdot343$, we see that denominator $=1\cdot343-1=0\cdot343$

$$a=£\frac{201\cdot4}{0\cdot343}=£587\cdot2$$

153 $(6^2\times5000)$ cu cm are discharged per 1 min (see Art 247, Ex 3), 1000 cu cm, or 1 litre are discharged per $\frac{1}{6^2\times5}$ min, i e 30000 lit are discharged per $\frac{30000}{36\times5}$ min, or $166\frac{2}{3}$ min

154 Suppose the clients deposit Rs x The interest from the preference stock $=$Rs $\frac{4}{150}\times\frac{x}{2}$, from the mortgages $=$Rs $\frac{5}{100}\times\frac{x}{4}$ He pays Rs $\frac{2}{100}\times x$ as interest on deposits

$$\frac{4}{150}\times\frac{x}{2}+\frac{5}{100}\times\frac{x}{4}-\frac{2x}{100}=10000$$

Multiply by 1200, and $16x+15x-24x=12000000$,

whence $x=17,14,286$ to nearest Re

155 Suppose there are x cu cm of the first and y cu cm of the second liquid Then their weights are $x\times0\cdot68$ gm, and $y\times1\cdot04$ gm, respectively

Similarly the weight of the mixture $=(x\times0\cdot82+y\times0\cdot82)$ gm

$$x\times0\cdot68+y\times1\cdot04=x+0\cdot82+y\times0\cdot82, \text{ and } \frac{x}{y}=\frac{11}{7}$$

Hence $x=\frac{11}{18}$, and $y=\frac{7}{18}$, of the whole mixture

$x=\frac{11}{18}\times100\,\%=61\cdot1\,\%$, and $y=\frac{7}{18}$ of $100\,\%=38\cdot9\,\%$

156 Since 1 5 sq in is increased to 1 sq ft, or 144 sq in,

1 sq in „ $\frac{144}{1\cdot5}$, or 96 sq in,

1 in „ $\sqrt{96}$ in, or 9 8 in

Hence 4 in „ $9\cdot8\times4$, or 39 2 in,

and 6 in „ $9\cdot8\times6$, or 58 8 in

the least dimensions are 59 in and 40 in

157 Let a unit of work = work of one boy in one hour

A man = $\frac{7}{4}$ boys

$\frac{\{(14\times\frac{7}{4})+13\}\times 3\times 2}{5}$ = no of units of work to be done

$= \frac{7}{2}\frac{5}{}\times\frac{6}{5} = 45$ units

If for this work there are x men,

there must be $27-x$ boys

Then $x\times\frac{7}{4}+(27-x)=45$

$$7x+108-4x=180,$$
$$3x=72,$$
$$x=24$$

So there are 24 men and 3 boys

10 boys are replaced by that no of men

158 Let x = no of Kms per hour travelled by motor car

Then $\frac{120x}{100}$ = " " " train

$$\frac{75}{x}=\frac{75}{\frac{120x}{100}}+\frac{12\frac{1}{2}}{60},$$
$$\frac{75}{x}=\frac{750}{12x}+\frac{25}{120},$$
$$9000=7500+25x,$$
$$25x=1500,$$
$$x=60$$

159 Let Rs x be the retail price per gross Since a royalty of 10% is paid and discount of 40% is allowed, $\frac{\text{Rs }50}{100}x$, or $\frac{\text{Rs }x}{2}$ is the net receipt per gross by the manufacturer

But this allows a profit of 25% on Rs 170,

$\frac{x}{2}=170\times\frac{125}{100}$, whence x = Rs 425 per gross

price per article = Rs 2 15 a 3 p

For second part of question, the net receipts on each article are $\frac{50}{100}$ of Rs 3 But each article costs $\frac{\text{Rs }170}{144}$

req^{d} profit = Re $\frac{2}{7}\frac{3}{2}=5\frac{1}{9}$ a

160 The line for the Latin marks is found by joining the points (51, 30) and (153, 120), and for the Greek marks by joining (56, 40) and (161, 100)

The most convenient scale is that of 10 marks to the inch for each case, beginning at 50 for the unreduced marks and at 30 for the reduced marks

The figure will however be large

The two lines cut at a point whose coords are approximately (74, 50) Hence an actual mark of 74, either in Latin or Greek, appears as 50 when reduced

161 Since 15 mi per hr $=22$ ft per sec,

in 50 min he is nearer the fort by $50\times22\times60$ ft

But the interval between the 1st and the 52nd report is 51 min, sound takes 1 min to travel $50\times22\times60$ ft,

giving a speed of 1100 ft per sec

162 The volume of water flowing through the pipe per sec is that of a cylinder whose base area is $\pi\ 6^2$ in, or $\pi\ \frac{1}{4}$ sq ft, and whose height is 1 ft, giving $\frac{\pi}{4}$ cu ft

If the req^d time be x hrs, then in this time $\left(\frac{\pi}{4}\times x\times60\times60\right)$ cu ft are discharged

But this must equal a cuboid of water whose base area is $(20\times48\frac{1}{2}\times9)$ sq ft, and whose depth is $\frac{1}{12}$ ft

$$\frac{\pi}{4}\times x\times60\times60=20\times4840\times9\times\frac{1}{12}$$

$$x=\frac{20\times4840\times9\times4}{3\cdot14159\times60\times60\times12}=\frac{242}{3\cdot14159\times3}=\frac{242}{9\cdot42477}=25\cdot68$$

163 Income at first $=\text{Rs}\ \dfrac{11625\times3\frac{1}{2}}{97\frac{1}{2}}$

$$=\frac{14625\times7\times2}{195}$$

$$=\text{Rs}\ 525$$

2nd income $=\text{Rs}\ \dfrac{14625\times98\times4}{97\frac{1}{2}\times112}$

$$=\frac{14625\times98\times4\times2}{112\times195}$$

$$=\text{Rs}\ 525$$

Thus there is no change in income

164 $\text{Cost} = \text{Rs } \frac{£1030\ 7s\ 6d}{1s\ 3\frac{15}{16}d}$

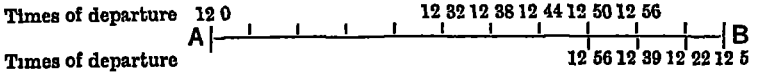
$= \frac{247290}{15\frac{15}{16}}$

$= \frac{247290 \times 16}{255}$

$= \frac{263776}{17}$

$= \text{Rs } 15{,}516\ 3a\ 9p$

165 Fast train ——→



←—— Slow train

The above diagram shews that if the line were double, the trains would pass each other between the 2nd and 3rd stations from B, also the times for the trains at these stations shew the required station is the 2nd out from B

166 Every 62 3 lbs weight of the man displaces 1 cu ft of water, hence req^d volume $= \frac{140}{62.3}$ cu ft, or 2 25 cu ft

For the second part of the question, if x be the req^d number the total volume occupied by the men $= 2\ 25 \times x$ cu ft

But this is $\frac{90}{100}$ of $360 \times 40 \times 5\frac{1}{2}$ cu ft,

$2\ 25x = \frac{90}{100}$ of $360 \times 40 \times 5\frac{1}{2}$, or $x = \frac{360 \times 40 \times 90 \times 11}{225 \times 100 \times 2} = 360 \times 8 \times 11$

$= 31680$, giving 31700 to nearest hundred

167 The volume of water passing the bridge per hour is $180 \times 36 \times 17500$ cu dec, giving $\frac{180 \times 36 \times 17500}{60}$ cu dec per min, or 1890000 litres per min

168 Cost for the ordinary burners

$= 33d \times \frac{3\frac{1}{2}}{1000} \times 96 \times 13 \times 26$ (6 months $= 26$ weeks)

$= \frac{33 \times 7 \times 96 \times 13 \times 26}{2000} = 3747\ 744a$

Amt saved $= 0\ 33$ of $3747\ 744a = \text{Rs } 77\ 4a\ 9p$

169 Amt of guaranteed stock and preference stock

$= £17904062 + £11925808 = £29829870$

Half year's dividend on this at 5 %

$= \frac{1}{40}$ of $£29829870 = £745746\ 75$

If exactly £40000 is carried over, the amount for the dividend on ordinary stock would be

£1492156 5875 – [£40000 + £745746 75],

or £1492156 5875 – £785746 75,

or £706409 8375

On this supposition the req^{d} percentage per half year would be

$$\frac{£706409\ 8375 \times 100}{£35538259}, \quad \text{or} \quad \frac{£7064}{3554}$$

This is greater than $1\frac{3}{4}$ and less than 2, and nearer to the latter value But if 2 % is taken, the sum carried over will clearly be not as much as £40000 Thus to satisfy the conditions of the question, we must take $1\frac{3}{4}$ %

Now $1\frac{3}{4}$ % on £35538259

$= (2 - \frac{1}{4})$ of £355382 59

= £710765 18 – £88845 6475

= £621919 5325 (interest on ordinary stock) (1)

The interest on the other stock = £745746 75 (2)

Adding (1) and (2) we obtain for total interest

£1367666 2825

amount carried over = £1492156 5875 – £1367666 2825

= £124490 3 = £124490 6*s*

170 From Art 284, III,

$$\frac{\text{Volume of statuette}}{\text{Volume of model}} = \frac{10^3}{48^3} = \frac{5^3}{24^3} = \frac{125}{13824}$$

Supposing the statuette were made of plaster, it would weigh $\frac{125}{13824}$ of 150 lbs Since, however, silver is 12 9 times as heavy as plaster, it weighs $\frac{125}{13824}$ of 150 × 12 9 lbs,

or $\frac{125 \times 50 \times 4\ 3}{1536}$ lbs, or 17 5 lbs

171 36 in is correct length of unit, 36 18 is incorrect length of unit

Now the greater the measure of the unit, the smaller the number of units in any distance Hence we have

$$\frac{\text{correct measurement of side}}{\text{incorrect measurement of side}} = \frac{36\ 18}{36} = \frac{1{\cdot}005}{1}$$

$$\frac{\text{correct measurement of area}}{\text{incorrect measurement of area}} = \left(\frac{1\ 005}{1}\right)^2 = \frac{1\ 010025}{1}$$

Now 1 010025 > 1 by 0 010025, *i e* by 1 0025 %

172 Let V_1, V_2 be the volumes of the spheres
„ s_1, s_2 „ sp gravities „
„ W_1, W_2 „ weights „
„ r_1, r_2 „ radii „

Then from Art 247, Ex 1, we see that $\frac{V_1 s_1}{V_2 s_2} = \frac{W_1}{W_2}$

But $\frac{V_1}{V_2} = \frac{r_1^3}{r_2^3}$, $\frac{r_1^3 s_1}{r_2^3 s_2} = \frac{W_1}{W_2}$ Substituting given values,

$$\frac{r_1^3 \times 289}{r_2^3 \times 64} = \frac{8}{17}, \text{ and } \frac{r_1^3}{r_2^3} = \left(\frac{8}{17}\right)^3, \text{ or } \frac{r_1}{r_2} = \frac{8}{17}$$

173 Their invested capitals are in the proportion 6 4 3
A uses whole capital for 4 months,
and half „ 8 „
B and C each use whole capital for 12 months
then shares of the profits are in the proportion

$$(6\times4)+(3\times8) \quad 4\times12 \quad 3\times12,$$
$$\text{i e} \quad 48 \quad 48 \quad 36,$$
$$\text{i e} \quad 4 \quad 4 \quad 3$$

So A has $\frac{4}{11}$ of Rs $2024 = $ Rs 736

174 The increase in first population is $45682 \times 0\,08$, in the second, $25408 \times 0\,045$, the decrease in the third is $18960 \times 0\,1$ If x be the req^{d} average increase per cent, this actual increase is

$$(45682+25408+18960)\times\frac{x}{100}, \text{ or } 90050\times\frac{x}{100}$$

$$90050\times\frac{x}{100} = 45682\times0\,08+25408\times0\,045-18960\times0\,1,$$
$$\text{or } 900\,5x = 3654\,56+1143\,36-1896,$$
$$\text{whence } x = \frac{2901\,92}{900\,5} = 3\,2$$

175 Since 2s 8d per cwt $=$ £2 13s 4d per ton,
each ton of ore costs him £8 16s 8d + £2 13s 4d, or £11½
But only $\frac{2}{100}$ of this is copper, of which only 92 % can be extracted and sold Hence if £x be req^{d} price,

$$\frac{92}{100} \text{ of } \frac{23}{100} \text{ of } x = 11\tfrac{1}{2}\times\frac{11}{100} \text{ (see Art 292)},$$
$$x = \frac{23}{2}\times\frac{115}{100}\times\frac{100}{92}\times\frac{100}{23} = £62\ 10s$$

176 Suppose the thickness of a halfpenny is x in,
then the thickness of a penny is $1\cdot23x$ in
volume of halfpenny $=0\cdot7854\times1^2\times x$ cu in,
and volume of penny $=0\cdot7854\times(1\cdot23)^2\times1\cdot23x$ cu in

$$\text{req}^{\text{d}}\text{ fraction}=\frac{0\cdot7854\times1^2\times x}{0\cdot7854\times(1\cdot23)^2\times1\cdot23x}=\frac{1}{(1\cdot23)^3}=\frac{1}{1\cdot861}=0\cdot54$$

177 Marked price = nominal cost price $\times\frac{107}{100}$ (see Art 289)
But because of the fraudulent balance,

$$\frac{\text{nominal cost price}}{\text{actual cost price}}=\frac{1+\frac{1}{15}}{1}=\frac{16}{15},$$

nominal cost price = actual cost price $\times\frac{16}{15}$
Hence marked price = actual cost price $\times\frac{16}{15}\times\frac{107}{100}$
= actual cost price $\times\frac{112}{100}$,
and req^{d} gain = 12 %

178

I	II	III
8 wine, 8 water	9 wine, 15 water	4 wine, 28 water

In II there is room for 8 more gallons
after filling up II from III there are

$$\begin{cases}(9+\frac{4}{12}\text{ of }8)\text{ wine},\\(15+\frac{8}{32}\text{ of }8)\text{ water},\end{cases}\ i.e.\ \begin{cases}10\text{ wine},\\22\text{ water}\end{cases}$$

In I there is room for 16 more gallons
after filling up I from II there are

$$\begin{cases}(8+\frac{10}{12}\text{ of }16)\text{ wine},\\(8+\frac{8}{32}\text{ of }16)\text{ water},\end{cases}\ i.e.\ \begin{cases}13\text{ wine},\\19\text{ water}\end{cases}$$

179 Area of enclosure $=(10\times4840\times9)$ sq ft
length of its side $=\sqrt{(48400\times9)}$ ft
$=660$ ft
length of street $=(4\times660)$ ft
and its width is 30 ft
no of paving stones $\text{req}^{\text{d}}=4\times660\times30\times\frac{4}{3}$
$=110400$

180 Let £v = present value of bill,

then $v\frac{304}{300} = 513$

$$v = \frac{513 \times 300}{304}$$

$$= 506\tfrac{1}{4}$$

$$= £506\ 5a$$

total assets = £1422 10s 4d

and debts = £2134 10s 6d

he pays in the pound $£\frac{1422\,516}{2134\,525}$

$$= £\,666$$

$$= 13s\ 4d$$

181 The decimal evidently terminates when the denominator is (i) any power of 10, (ii) any power of 2, (iii) any power of 5, (iv) a product of any power of 2 and any power of 5 And (i) is included in (iv)

But, after the fraction has been reduced to its lowest terms, with any of the other nos, 3, 6, 7, 9, 11, etc, as denominator, or as a factor in the denominator, the decimal does not terminate

$\frac{110}{130} = \frac{7}{8}$, where $8 = 2^3$ the decimal terminates

182 (i) $A+B+C$ do $\frac{1}{18}$ of the work in 1 day

(ii) $B+C+D$ „ $\frac{1}{20}$ „ „

(iii) $C+D+A$ „ $\frac{1}{24}$ „ „

(iv) $D+A+B$ „ $\frac{1}{27}$ „ „

combining (i) and (ii), $A-D = \frac{1}{18} - \frac{1}{20} = \frac{10-9}{2\ 9\ 10} = \frac{1}{180}$

„ (i) „ (iii), $B-D = \frac{1}{18} - \frac{1}{24} = \frac{8-6}{3\ 6\ 8} = \frac{1}{72}$

$$A+B-2D = \frac{1}{180} + \frac{1}{72} = \frac{2+5}{9\ 4\ 5\ 2} = \frac{7}{9\ 4\ 5\ 2}$$

But (iv) $A+B+D = \frac{1}{3\ 9}$

$$3D = \frac{1}{3\ 9} - \frac{7}{9\ 4\ 5\ 2}$$

$$= \frac{40-21}{3\ 9\ 4\ 5\ 2}$$

$$= \frac{19}{10\,8\,0}$$

D does $\frac{19}{3\,4\,0}$ of the work in 1 day

$A+B+C+D$ do $\frac{1}{18}+\frac{19}{3\,40}$ in 1 day

$=\frac{180+19}{3\,40}$

$=\frac{199}{3\,240}$

$A+B+C+D$ do the work in $\frac{3240}{199}$ days,

i e in $16\frac{56}{199}$ days

183 Let Rs x = marked price of article

Then Rs $\frac{95x}{100}$ = price obtained from customer

But Rs $712\frac{1}{2}\times\frac{4}{3}$ = " " "

$\frac{95x}{100}=712\frac{1}{2}\times\frac{4}{3}$,

$\frac{19x}{20}=\frac{1425}{2}\times\frac{4}{3}$,

$19x=19000$,

$x=1000$

marked price = Rs 1000

184 1st income = Rs $\frac{44100}{98}\times\frac{7}{2}$

= Rs 1575

2nd income = Rs $\frac{44100\times98\frac{1}{2}\times5}{98\times110\frac{3}{16}}$

= Rs $\frac{44100\times197\times5\times16}{98\times2\times1773}$

= Rs 2000

increase in income = Rs (2000 − 1575)

= Rs 425

185 The loser runs $9\frac{1}{11}$ yds in 1 sec

he runs 100 yds in $\frac{100}{9\frac{1}{11}}$ secs,

i e 11 secs

The winner takes 1 sec less

he runs 100 yds in 10 secs

100 yds in 10 secs = $\frac{100\times60\times60}{1760\times10}$ miles per hour

$=20\frac{5}{11}$ " "

100 yds in 11 secs = $\frac{100\times60\times60}{1760\times11}$ miles per hour

$=18\frac{72}{121}$ " "

186 When B has once completed the course A is not half way round
So B, while going round the second time, will catch up A
Let v = no of secs from start before they are together again

In v secs A goes $\frac{v}{224}$ of the course

" B goes once round and $\frac{v}{224}$ of the course,

$$i.e.\ \frac{224+v}{224}$$

But in v secs B goes $\frac{v}{88}$ of the course

$$\frac{v}{88}=\frac{224+v}{224},$$
$$224v=19712+88v,$$
$$136v=19712,$$
$$v=144\tfrac{16}{17}\text{ secs}$$

87 Interest paid = Rs $\frac{250\times3\times3}{4\times100}=\frac{45}{8}$ = Rs 5 10 a

Interest obtained = Rs 5 10 a + Rs 2 13 a = Rs 8 7 a.

Let r = rate of interest obtained

Then
$$\frac{250\times3\times r}{4\times100}=8\tfrac{7}{16},$$
$$\frac{15r}{8}=\frac{135}{16},$$
$$r=\tfrac{9}{2}=4\tfrac{1}{2}\%$$

188

Original value = Rs	54321
Less 5 %	2716 05
After 1 yr =	51604 95
Less 5 %	2580 2475
After 2 yrs =	49024 7025
Less 5 %	2451 235125
After 3 yrs =	46573 467375
Less 5 %	2328 673368
After 4 yrs =	44244 794
Less 5 %	2212 2397
After 5 yrs =	42032 5543
Less 5 %	2101 6277
After 6 yrs =	39930 9266

i.e. value to the nearest rupee = Rs 39931

189 Let x = no of minute spaces covered by hour hand before hands coincide

Then $12x$ = no of minute spaces covered by minute hand

$$12x - 60 = x,$$
$$11x = 60,$$
$$x = \frac{60}{11} = 5\frac{5}{11}$$

So that hands should coincide after $65\frac{5}{11}$ mins

But they coincide after 66 mins of correct time

in 66 mins. of correct time clock is $\frac{5}{11}$ min slow

" 60×24 " " " $\frac{5 \times 24 \times 60}{11 \times 60}$ min slow

$= 10\frac{10}{11}$ "

$= 11\frac{1}{11}$ "

190 While D goes 440 yds, C goes 121 yds

" " " B " $\frac{121 \times 440}{440}$ yds

" " " 1 " $\frac{440 \times 440 \times 121}{441 \times 441}$ yds

$= 132\frac{7}{9}\frac{1}{8}\frac{1}{1}$ yds

D wins by $7\frac{1}{9}\frac{8}{8}\frac{1}{1}$ yds

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